

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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ENGINEERING: A CONTINUING
BIBLIOGRAPHY WITH INDEXES
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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

INTRODUCTION

This issue of *Aeronautical Engineering—A Continuing Bibliography* (NASA SP-7037) lists 623 reports, journal articles, and other documents originally announced in August 1992 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

Accession numbers cited in this issue are:

STAR (N-10000 Series) N92-24071 — N92-26170

IAA (A-10000 Series) A92-36525 — A92-40949

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the publication consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals.

Seven indexes—subject, personal author, corporate source, foreign technology, contract number, report number, and accession number—are included.

A cumulative index for 1992 will be published in early 1993.

Information on availability of documents listed, addresses of organizations, and NTIS price schedules are located at the back of this issue.

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TYPICAL REPORT CITATION AND ABSTRACT

NASA SPONSORED
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ACCESSION NUMBER → **N92-10979***# United Technologies Research Center, East Hartford, CT. ← CORPORATE SOURCE

TITLE → **DEVELOPMENT OF UNSTEADY AERODYNAMIC ANALYSES FOR TURBOMACHINERY AEROELASTIC AND AEROACOUSTIC APPLICATIONS**

AUTHORS → **JOSEPH M. VERDON, MARK BARNETT, KENNETH C. HALL, and TIMOTHY C. AYER** Washington NASA Oct. 1991 112 p ← PUBLICATION DATE

CONTRACT NUMBER → (Contract NAS3-25425)

REPORT NUMBERS → (NASA-CR-4405; E-6528; NAS 1.26:4405; R91-957907-3) Avail: ← COSATI CODE

AVAILABILITY SOURCE → NTIS HC/MF A06 CSCL 01/1

PRICE CODE →

Theoretical analyses and computer codes are being developed for predicting compressible unsteady inviscid and viscous flows through blade rows. Such analyses are needed to determine the impact of unsteady flow phenomena on the structural durability and noise generation characteristics of turbomachinery blading. Emphasis is being placed on developing analyses based on asymptotic representations of unsteady flow phenomena. Thus, flow driven by small-amplitude unsteady excitations in which viscous effects are concentrated in thin layers are being considered. The resulting analyses should apply in many practical situations, lead to a better understanding of the relevant physics, and they will be efficient computationally, and therefore, appropriate for aeroelastic and aeroacoustic design applications. Under the present phase (Task 3), the effort was focused on providing inviscid and viscous prediction capabilities for subsonic unsteady cascade flows.

Author

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED

ACCESSION NUMBER → **A92-13210*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA. ← CORPORATE SOURCE

TITLE → **PROBE SHAPES FOR STREAMWISE MOMENTUM AND CROSS-STREAM TURBULENCE INTENSITY**

AUTHOR → **VERNON ROSSOW, J.** (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol. 28, Nov. 1991, p. 741-749. refs Copyright ← JOURNAL TITLE

← AUTHORS' AFFILIATION

When the highly turbulent flowfields at the edges of jets, in augmentors, and in other jet-mixing devices are surveyed with conventional pitot probes, the values indicated by the instruments may contain a significant increment brought about by the dynamics of the eddies. Although the influence of turbulence on the measurements is usually negligible in streams where the turbulence level is 1 percent or less, the effect of turbulence on static and total pressure measurements can be around 20 percent when the turbulence level exceeds 40 percent. This paper describes a theoretical study that develops probe shapes that directly measure the time-averaged total pressure based on the streamwise component of the velocity vector to obtain a direct measurement of the streamwise momentum. The difference between the time-averaged pressure indicated by such a probe and one that measures the total head based on the entire velocity vector yields the cross-stream turbulence intensity.

Author

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September 1992

01

AERONAUTICS (GENERAL)

A92-36897

BLADE REPAIR WITH ADAPTIVE VISION TRACKING

J. R. ANDERSON and M. J. SKINNER (Ferranti Sciaky, Inc., Chicago, IL) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 114, no. 2, April 1992, p. 323-327. refs

(ASME PAPER 91-GT-208) Copyright

The paper discusses the repair welding of compressor and other blades contained in gas turbine engines. The specific topics of discussion are the application requirements, the general metallurgical considerations, the synchronized pulsation arc welding process, the adaptive vision system employed and the computer-controlled welding system. Reference to an actual installation of this technology will be included. Author

A92-37061

DIMENSIONAL CHARACTERIZATION OF A LARGE AIRCRAFT STRUCTURE BY PHOTOGRAMMETRY

CLIVE S. FRASER (Geodetic Services, Inc., Melbourne, FL) and JAMES A. MALLISON (Douglas Aircraft Co., Long Beach, CA) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 58, no. 5, May 1992, p. 539-543. refs Copyright

An application of industrial photogrammetry to the dimensional characterization of a large aircraft structure is described. The aim of the project is to establish the degree of structural correspondence between the as-built development fixture for a large transport aircraft and its design which was embodied in a CAD database. The measurement task involved the photogrammetric positioning to 0.2-mm accuracy of more than 1400 points on interior loft surfaces. Aspects of the photogrammetric survey - network design considerations, photography, and data processing - are discussed, and an analysis of the results is presented. Author

A92-37875

NASA'S QUIET SIDE. I

NIGEL MACKNIGHT Air International (ISSN 0306-5634), vol. 42, no. 5, May 1992, p. 240-243.

Copyright

A review is presented of the Quiet Short-Haul Research Aircraft (QSRA), a modified DHC-5 Buffalo developed by a NASA/Boeing team to facilitate investigations of powered-lift technologies that confer exceptional STOL performance and drastically reduce the acoustic 'footprint' an aircraft makes on the ground below. The QSRA's principal feature is its over-the-wing engine installations that permits the turbofan engines to exhaust over the top surface of a wing optimized for powered-lift, generating three times the lift of a conventional wing at low flying speeds. At 48,000 lb, the QSRA's lift-off airspeed is only 71 kts while its landing speed is 65 kts. Attention is given to other operational performance tests including high-descent-rate landing approaches, noise-reduction

measurements, Category 3A approaches and landings, and carrier landings and takeoffs without benefit of arresting gear or catapult. R.E.P.

A92-38101

A REVOLUTION IN AIR TRANSPORT - ACQUIRING THE C-141 STARLIFTER

ROGER D. LAUNIUS and BETTY R. KENNEDY (USAF, Military Airlift Command, Scott AFB, IL) Airpower Journal (ISSN 0897-0823), vol. 5, no. 3, Fall 1991, p. 68-83. refs Copyright

The acquisition of the C-141 Starlifter by the DOD is reviewed and discussed. Attention is given to the political cold war context and the USAF's response to these political requirements. The reports and Congressional investigations involved in the acquisition are reexamined. The role of the C141 in the United States flexible response strategy is addressed. Finally, the development and acquisition of the C-141 are reviewed and the value of the program is assessed. C.D.

A92-38201

INTERNATIONAL AEROSPACE SYMPOSIUM 90, NAGOYA, JAPAN, NOV. 26, 27, 1990, PROCEEDINGS

Symposium sponsored by Chubu Aeronautics and Space Technology Development Association. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, 166 p. In Japanese and English. For individual items see A92-38202 to A92-38220.

The present conference discusses intelligent adaptive structures, space robots, design considerations of space structures, solar sail design, tilt-wing aircraft, the Asuka quiet STOL research aircraft, a prospective civil STOL transportation system, commuter helicopters, the scientific use of Space Station Freedom, materials science in space, and earth observations from space. Also discussed are the human exploration of Mars, advanced aerospace structures, materials and structures for ESA's Hermes manned vehicle, robotics applications in aerospace manufacturing, aircraft maintenance, novel processes in commercial aircraft design, and computer-integrated manufacturing. O.C.

A92-38217

AIRCRAFT MAINTENANCE SUPPORT SYSTEM

MASATO TSUKAMOTO (Kawasaki Heavy Industries, Ltd., Kobe, Japan) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 131-138. In Japanese. refs

Advanced technologies are being applied to aircraft and ground support equipment for maintenance work. Voice synthesizers or voice recognizers are being developed and are being improved for practical use. Computer software for the aircraft maintenance support system is discussed. Y.P.Q.

A92-38218

NEW PROCESSES IN COMMERCIAL AIRPLANE DESIGN

M. R. JOHNSON and STEVEN G. LYNN (Boeing Commercial Airplane Group, Seattle, WA) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 140-147.

An evaluation is made of the procedures that extensive reliance

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01 AERONAUTICS (GENERAL)

on CAD-CAM will institute in the design of the B 767-X airliner. Among the staff members affected will be engineering designers and analysts, manufacturing planners, tool designers, numerically-controlled machine tool programmers, and customer service personnel. Computers will be used not only to design all components of the aircraft, but to integrate them in simulated assemblies and ensure proper fits and interfaces. Much error and rework associated with assembly and parts interference will in this way be precluded. O.C.

A92-38220

PRODUCTION TECHNOLOGIES AND AIRCRAFT DESIGN

TSURUO TORIKAI (Japan Aircraft Development Corp., Tokyo) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 159-163. In Japanese.

The development of materials for Japanese military aircraft since World War II is reviewed. Integrating the manufacturing technology from the early phase of the aircraft design is described. Y.P.Q.

A92-38266

AEROSPACE - COLLECTED TRANSLATIONS OF SELECTED PAPERS

Xian, People's Republic of China, Northwestern Polytechnical University, 1991, 71 p. Translation. For individual items see A92-38267 to A92-38274.

Copyright

The present volume on aerospace technologies and methods encompasses the modeling of aircraft engines and airframes, computational fluid dynamics, the aerodynamic characteristics of airfoils, turbulent flows, target recognition and tracking, and aircraft stability. The specific issues addressed include a dynamic digital model for a turbojet with a pulse-monitored fueler, the architecture of a supercomputer designed for fluid-field computation, and the solution of Euler equations for the forebody-inlet configurations of a fighter aircraft at high angles of attack. Also addressed are the aerodynamic analyses of airfoils, the calculation of turbulent flow using a general nonorthogonal curvilinear coordinate system, an algorithm for initiating the tracking of multiple maneuvering targets, and a separated algorithm for flight-test applications. C.C.S.

A92-39968* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

COMPARISON OF ELASTIC AND RIGID BLADE-ELEMENT ROTOR MODELS USING PARALLEL PROCESSING TECHNOLOGY FOR PILOTED SIMULATIONS

GARY HILL (NASA, Ames Research Center, Moffett Field, CA), RONALD W. DU VAL, JOHN A. GREEN, and LOC C. HUYNH (Advanced Rotorcraft Technology, Inc., Mountain View, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 19 p. Previously announced in STAR as N91-32071. refs

(SAE PAPER 912120) Copyright

A piloted comparison of rigid and aeroelastic blade-element rotor models was conducted at the Crew Station Research and Development Facility (CSRDF) at Ames Research Center. A simulation development and analysis tool, FLIGHTLAB, was used to implement these models in real time using parallel processing technology. Pilot comments and qualitative analysis performed both on-line and off-line confirmed that elastic degrees of freedom significantly affect perceived handling qualities. Trim comparisons show improved correlation with flight test data when elastic modes are modeled. The results demonstrate the efficiency with which the mathematical modeling sophistication of existing simulation facilities can be upgraded using parallel processing, and the importance of these upgrades to simulation fidelity. Author

A92-39969* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

A REVIEW OF RECENT PROGRAMS AND FUTURE PLANS FOR ROTORCRAFT IN-FLIGHT SIMULATION AT AMES RESEARCH CENTER

MICHELLE M. ESHOW (U.S. Army, Aeroflightdynamics Directorate,

Moffett Field, CA), EDWIN W. AIKEN, WILLIAM S. HINDSON, J. V. LEBACQZ, and DALLAS G. DENERY (NASA, Ames Research Center, Moffett Field, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 15 p. refs

(SAE PAPER 912121) Copyright

A new flight research vehicle, the Rotorcraft-Aircrew Systems Concepts Airborne Laboratory (RASCAL), is being developed by the U.S. Army and NASA at Ames Research Center. The requirements for this new facility stem from a perception of rotorcraft system technology requirements for the next decade together with operational experience with the CH-47B research helicopter that was operated as an in-flight simulator at Ames during the past 10 years. Accordingly, both the principal design features of the CH-47B variable-stability system and the flight-control and cockpit-display programs that were conducted using this aircraft at Ames are reviewed. Another U.S. Army helicopter, a UH-60A Black Hawk, has been selected as the baseline vehicle for the RASCAL. The research programs that influence the design of the RASCAL are summarized, and the resultant requirements for the RASCAL research system are described. These research programs include investigations of advanced, integrated control concepts for achieving high levels of agility and maneuverability, and guidance technologies, employing computer/sensor-aiding, designed to assist the pilot during low-altitude flight in conditions of limited visibility. The approach to the development of the new facility is presented and selected plans for the preliminary design of the RASCAL are described.

Author

A92-39983

AGILITY AND HIGH ANGLE OF ATTACK - AN AIR FORCE RESEARCH PERSPECTIVE

JEFFREY A. BECK, THOMAS J. CORD (USAF, Wright Laboratory, Wright-Patterson AFB, OH), and MARK J. DETROIT (Dayton, University, OH) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 10 p. refs (SAE PAPER 912145) Copyright

Research in agility and supermaneuverability which will enable the Air Force to specify agility requirements for and evaluate the maneuverability of future aircraft is briefly discussed. A basic plan for achieving enhanced agility is summarized. Definitions of related terminology are given. C.D.

A92-40383

FUTURE CONSIDERATIONS FOR VERTICAL FLIGHT

CARL B. SCHELLENBERG (FAA, Los Angeles, CA) Vertiflite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 13-16. Copyright

The role of vertical flight in the aviation services of the 21st century is addressed, with an emphasis on the Pacific Rim region. The potential of vertical flight technology to help reduce airport congestion is examined, and accomplishments that have already been made toward achieving vertical flight goals are reviewed.

C.D.

A92-40386

AN ANALYSIS TOOL FOR UAV EFFECTIVENESS EVALUATION

RICHARD E. SHEFFIELD (Boeing Defense and Space Group, Philadelphia, PA) Vertiflite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 31-37.

Copyright

A computerized model is discussed which can be used as a tool in determining how effectively a UAV with given performance characteristics can perform a typical UAV mission. The tool can also be used in analyses of air vehicle characteristics and to change mission scenarios while performing sensitivity analyses.

C.D.

A92-40392

1991-92 AHS TECHNICAL COMMITTEE HIGHLIGHTS - AIRCRAFT DESIGN

JOSEPH WILKERSON (Boeing Defense and Space Group, Helicopters Div., Philadelphia, PA) Vertiflite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 76-80.
Copyright

Progress made in 1991-92 in developing civil and military rotorcraft is reviewed. The state of development, flight tests, and research on a variety of rotorcraft, including the RAH-66 Comanche, light attack helicopter, V-22 tiltrotor, and Eurocopter Tiger attack helicopter, are described. C.D.

A92-40394* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

1991-92 AHS TECHNICAL COMMITTEE HIGHLIGHTS - FLIGHT SIMULATION

THOMAS S. ALDERETE (NASA, Ames Research Center, Moffett Field, CA) Vertiflite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 84-86.
Copyright

Significant developments in helicopter flight simulation and research programs during 1991-92 are reviewed. Emphasis is given to an update on in-flight simulation activities. C.D.

A92-40396

1991-92 AHS TECHNICAL COMMITTEE HIGHLIGHTS - MANUFACTURING AND PRODUCT ASSURANCE

DREW G. ORLINO (U.S. Army, Washington, DC) Vertiflite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 90-92.
Copyright

Advances made in 1991-92 in manufacturing and product assurance for the RAH-66 Comanche helicopter are briefly addressed. The new technologies considered include the large composite cocure structures, automated trim and drill cell, automated fly placement cell, advanced split torque path transmission, and CATIA data base. C.D.

A92-40397

1991-92 AHS TECHNICAL COMMITTEE HIGHLIGHTS - STRUCTURES AND MATERIALS

REX LIU (McDonnell Douglas Helicopter Co., Mesa, AZ) Vertiflite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 94-97.
Copyright

Advances made in structures and materials technology for helicopters in 1991-92 are briefly reviewed. Emphasis is given to progress in composite structures in a variety of aircraft. C.D.

A92-40398

1991-92 AHS TECHNICAL COMMITTEE HIGHLIGHTS - TEST AND EVALUATION

PHIL DUNFORD (Boeing Defense and Space Group, Helicopters Div., Philadelphia, PA) Vertiflite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 97-105.
Copyright

Test and evaluation procedures for helicopters conducted at a number of manufacturers, at the FAA, and at NASA Ames and Langley Research Center, the Army's Airworthiness Qualification Test Directorate (AQTD), and at the NAWC (Naval Air Warfare Center) are reviewed. The evaluations performed on a variety of helicopters are discussed. C.D.

A92-40880

SHEAR PROGRESS

GUY NORRIS and GRAHAM WARWICK Flight International (ISSN 0015-3710), vol. 141, no. 4315, April 22, 1992, p. 29-31.
Copyright

Advances in aircraft and aircraft-related technologies to recognize and handle windshear are reviewed. Emphasis is placed on progress from reactive to predictive technologies. The role of ground data links in detecting bursts is addressed. C.D.

N92-24678*# National Aeronautics and Space Administration, Washington, DC.

NASA AERODYNAMICS PROGRAM Annual Report, 1991

LOUIS J. WILLIAMS, KRISTIN A. HESSENIUS, VICTOR R. CORSIGLIA, GARY HICKS, PAMELA F. RICHARDSON, GEORGE

UNGER, BENJAMIN NEUMANN, and JIM MOSS Apr. 1992
245 p
(Contract NASW-4430)
(NASA-TM-4368; NAS 1.15:4368) Avail: NTIS HC/MF A11
CSCL 01B

The annual accomplishments is reviewed for the Aerodynamics Division during FY 1991. The program includes both fundamental and applied research directed at the full spectrum of aerospace vehicles, from rotorcraft to planetary entry probes. A comprehensive review is presented of the following aerodynamics elements: computational methods and applications; CFD validation; transition and turbulence physics; numerical aerodynamic simulation; test techniques and instrumentation; configuration aerodynamics; aeracoustics; aerothermodynamics; hypersonics; subsonics; fighter/attack aircraft and rotorcraft. Author

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

A92-36549

DETERMINATION OF PHYSICO-CHEMICAL CONSTANT IN THE WAKE OF A BODY FROM BALLISTIC EXPERIMENTS [OPREDELENIE FIZIKO-KHIMICHESKIKH KONSTANT V POTOKE ZA TELOM IZ BALLISTICHESKIKH EKSPERIMENTOV]

N. N. BAULIN, E. V. ERMAKOVA, and N. N. PILIUGIN (Moskovskii Gosudarstvennyi Universitet, Moscow, Russia) Teplofizika Vysokikh Temperatur (ISSN 0040-3644), vol. 30, no. 2, Mar.-Apr. 1992, p. 299-310. In Russian. refs

Copyright

Experimental data on electron concentration in the wake of a body are processed by solving linearized equations of a chemically nonequilibrium boundary layer describing laminar axisymmetric flow in the wake of a body traveling at a hypersonic velocity. Analytical expressions for the distribution of integral quantities related to electron concentration are obtained and used to determine the constants from electron concentration data using the least squares method. The obtained constants determine the initial wake diameter, temperature distribution along the axis, electron recombination rate, and the Schmidt number. V.L.

A92-36550

VIBRATIONAL RELAXATION EFFECTS IN HYPERSONIC FLOWS OF A VISCOUS GAS [EFFEKTY KOLEBATEL'NOI RELAKSATSII V GIPERZVUKOVYKH TECHENIIAKH VIAZKOGO GAZA]

V. G. SHCHERBAK (Moskovskii Gosudarstvennyi Universitet, Moscow, Russia) Teplofizika Vysokikh Temperatur (ISSN 0040-3644), vol. 30, no. 2, Mar.-Apr. 1992, p. 319-324. In Russian. refs

Copyright

Hypersonic flow past a body reentering the earth atmosphere along a gliding path is investigated analytically. Calculations of thermal fluxes are compared with surface temperature determinations based on different approximations of the relaxation time of VV-prime processes. The source terms in the vibrational relaxation equations are estimated, and the need for considering the inverse effect of chemical reactions on the vibrational energy balance is demonstrated. V.L.

A92-36552

NUMERICAL STUDY OF COUPLED HEAT TRANSFER UNDER CONDITIONS OF FILTERING AND FILM COOLING OF BLUNT ANISOTROPIC BODIES [CHISLENNOE ISSLEDOVANIE SOPRIAZHENNOGO TEPLOOBMENA V USLOVIYAKH FIL'TRATSII I PLENOCHNOGO OKHLAZHDEENIIA ZATUPLENNYKH ANIZOTROPNYKH TEL]

V. F. FORMALEV (Moskovskii Aviatsonnyi Institut, Moscow, Russia) Teplofizika Vysokikh Temperatur (ISSN 0040-3644), vol. 30, no. 2, Mar.-Apr. 1992, p. 334-344. In Russian. refs Copyright

A mathematical model and a numerical method are proposed for solving coupled problems in heat and mass transfer to determine the thermal state of blunt bodies under conditions of multidimensional anisotropic heat conduction, filtering, and film cooling. Results of numerical calculations are presented, and some practical recommendations are given. V.L.

A92-36600

SEPARATED AND CAVITATION FLOWS - PRINCIPAL PROPERTIES AND COMPUTATIONAL MODELS [OTRYVNYE I KAVITATSIONNYE TECHENIIA - OSNOVNYE SVOISTVA I RASCHETNYE MODELI]

LEV V. GOGISH (Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsonnogo Motorostroeniia, Moscow, Russia) and GEORGII I. STEPANOV (Moskovskii Gosudarstvennyi Universitet, Moscow, Russia) Moscow, Izdatel'stvo Nauka, 1990, 384 p. In Russian. refs (ISBN 5-02-014005-8) Copyright

The current concepts of separated flows of a viscous gas or a liquid past bodies involving turbulence and cavitation are examined. The fundamental properties of separated and cavitation flows are described, and methods for correlating experimental data are discussed. Schemes are presented for calculating two-dimensional (plane and axisymmetric) separated flows past bodies over wide ranges of M and Re numbers and cavitation conditions. The discussion also covers a viscous-nonviscous interaction model for cavitation and separation calculations, a model of jet flows and periodic wakes, body drag, and internal separated flows in ducts. V.L.

A92-36826

UNSTEADY FLOW PAST AN AIRFOIL PITCHING AT A CONSTANT RATE

C. SHIH, L. LOURENCO, L. VAN DOMMELEN, and A. KROTHAPALLI (Florida Agricultural and Mechanical University; Florida State University, Tallahassee) (International Symposium on Nonsteady Fluid Dynamics, Toronto, Canada, June 4-7, 1990, Proceedings, p. 41-50) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1153-1161. Previously cited in issue 16, p. 2661, Accession no. A91-38679. refs (Contract F49620-89-C-0014) Copyright

A92-36827 National Aeronautics and Space Administration, Washington, DC.

MULTIPOINT INVERSE AIRFOIL DESIGN METHOD BASED ON CONFORMAL MAPPING

MICHAEL S. SELIG and MARK D. MAUGHMER (Pennsylvania State University, University Park) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1162-1170. Previously cited in issue 06, p. 794, Accession no. A91-19124. refs (Contract NGT-50341) Copyright

A92-36830

EXPERIMENTAL INVESTIGATION OF SUPERSONIC FLOW OVER TWO CAVITIES IN TANDEM

XIN ZHANG and JOHN A. EDWARDS (Cambridge, University, England) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1182-1190. Research supported by Ministry of Defence Procurement Executive of England. Previously cited in issue 21,

p. 3289, Accession no. A90-45901. refs Copyright

A92-36834*

National Aeronautics and Space Administration, Langley Research Center, Hampton, VA.

EVALUATION OF A FINITE VOLUME METHOD FOR COMPRESSIBLE SHEAR LAYERS

H. L. ATKINS (NASA, Langley Research Center, Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1214-1219. Previously cited in issue 24, p. 3769, Accession no. A89-53770. refs Copyright

A92-36835

ACCELERATED CONVERGENCE TO STEADY STATE BY GRADUAL FAR-FIELD DAMPING

SMADAR KARNI (Michigan, University, Ann Arbor) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1220-1227. Previously cited in issue 17, p. 2851, Accession no. A91-40776. refs Copyright

A92-36836

LOCALLY IMPLICIT HYBRID ALGORITHM FOR STEADY AND UNSTEADY VISCOUS FLOWS

C. J. HWANG and J. L. LIU (National Cheng Kung University, Tainan, Republic of China) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1228-1236. refs Copyright

In the locally-implicit, hybrid finite-volume algorithm presented, mixed triangular and quadrilateral meshes are used for the numerical integration of the unsteady full Navier-Stokes equations in the Cartesian coordinate system. The convection-dominated part of the flowfield is formulated by an improved symmetric TVD scheme; the second- and fourth-order dissipative model on quadrilateral grids is introduced in the viscosity-dominated region to minimize numerical dissipation. The reliability and accuracy of the present algorithm on mixed meshes are confirmed by investigating the viscous flow over an oscillating flat plate. O.C.

A92-36838

National Aeronautics and Space Administration, Langley Research Center, Hampton, VA.

SPATIAL ADAPTATION OF UNSTRUCTURED MESHES FOR UNSTEADY AERODYNAMIC FLOW COMPUTATIONS

RUSS D. RAUSCH (Purdue University, West Lafayette, IN), JOHN T. BATINA (NASA, Langley Research Center, Hampton, VA), and HENRY T. Y. YANG (Purdue University, West Lafayette, IN) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1243-1251. Previously cited in issue 12, p. 1905, Accession no. A91-32022. refs (Contract NGT-50406) Copyright

A92-36839

ASYMPTOTIC DEFECT BOUNDARY-LAYER THEORY APPLIED TO HYPERSONIC FLOWS

B. AUPOIX, J. PH. BRAZIER, and J. COUSTEIX (ONERA, Centre d'Etudes et de Recherches de Toulouse, France) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1252-1259. refs Copyright

For hypersonic re-entry flows, the bow shock wave upstream of the spacecraft is the cause of an inviscid vortical flow in the shock layer. Prandtl's equations are unable to cope with outer flow vorticity, whereas Van Dyke's matched asymptotic expansions approach no longer gives a good matching of the viscous and inviscid solutions when the boundary layer is thick. A new approach, using a defect formulation in the viscous region together with a matched asymptotic expansions technique, has been developed. The so-derived equations are consistent with Prandtl's or Van Dyke's equations. Fair predictions are achieved for incompressible flows with external vorticity only with second-order solutions because displacement effects have to be accounted for, whereas

for hypersonic flows where displacement effects are weak, a good agreement with Navier-Stokes solutions is obtained with a first-order approach. Author

A92-36840* National Aeronautics and Space Administration, Washington, DC.

MULTIFRACTAL ANALYSIS OF A LOBED MIXER FLOWFIELD UTILIZING THE PROPER ORTHOGONAL DECOMPOSITION
L. UKEILEY, M. VARGHESE, M. GLAUSER, and D. VALENTINE (Clarkson University, Potsdam, NY) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1260-1267. Research supported by Cornell University, Clarkson University, and NASA. Previously cited in issue 06, p. 799, Accession no. A91-19340. refs

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A92-36842

SIMILARITY IN SUPERSONIC MIXING LAYERS

OTTO ZEMAN (Stanford University, CA) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1277-1283. refs

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This paper deals with similarity and parameterization in supersonic shear layers with isothermal freestreams, when the Mach number M (based on the velocity difference across the layer) is at least 3. With the support of modeling results and experiments, it is argued that under these conditions the turbulent velocity fluctuations are controlled by the local sonic speed, and the rms fluctuating Mach number approaches a saturation limit. These conditions permit inference of similarity laws and parametric expressions for the shear layer growth, maximum centerline magnitudes of temperature (or density), and Reynolds stresses. Turbulence closure simulations are shown to corroborate the proposed similarity theory and parameterization. An extension of the theory for mixing layers with different densities in the freestreams is proposed. Author

A92-36843

COMPRESSIBLE TURBULENT BOUNDARY LAYERS WITH HEAT ADDITION BY HOMOGENEOUS CONDENSATION

GUENTER H. SCHNERR, RAINER BOHNING (Karlsruhe, Universitaet, Federal Republic of Germany), THOMAS BREITLING (Daimler-Benz AG, Stuttgart, Federal Republic of Germany), and HANS-ARNO JANTZEN (Karlsruhe, Universitaet, Federal Republic of Germany) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1284-1289. Research supported by Volkswagen-Stiftung. refs

(Contract DFG-ZI-18/32)

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A combination of analytical and numerical methods is presently used to calculate homogeneous condensation in transonic viscous flow. The perturbation method for shock/boundary-layer interaction for adiabatic flow is extended for boundary layer flows with internal nonequilibrium heat addition. Attention is given to the macroscopic phenomena of nonequilibrium heat addition from the homogeneous condensation of water vapor in transonic flows, where high velocity and temperature gradients are normal to the main flow direction. While the friction coefficients change moderately, the displacement and momentum thickness are more sensitive to the onset of homogeneous condensation. O.C.

A92-36848* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, CA.

HIGH ALPHA AERODYNAMIC CONTROL BY TANGENTIAL FUSELAGE BLOWING

G. I. FONT and D. A. TAVELLA (Stanford University, CA) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1321-1330. Previously cited in issue 07, p. 974, Accession no. A91-21561. refs

(Contract NCC2-55)

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A92-36861* National Aeronautics and Space Administration, Langley Research Center, Hampton, VA.

TWO- AND THREE-DIMENSIONAL GRID GENERATION BY AN ALGEBRAIC HOMOTOPY PROCEDURE

ANUTOSH MOITRA (NASA, Langley Research Center, Hampton, VA) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1433, 1434. Previously cited in issue 16, p. 2484, Accession no. A90-38734. refs

Copyright

A92-36972

TURBOMACHINERY UNSTEADY LOAD PREDICTIONS WITH NONBUNIFORM INFLOW

SHIH H. CHEN (Rockwell International Corp., Rocketdyne Div., Canoga Park, CA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 3, May-June 1992, p. 667-673. Previously cited in issue 09, p. 1281, Accession no. A89-25368. refs

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A92-36974

EXPERIMENTAL STUDY OF A TWO-DIMENSIONAL SCRAMJET INSET, $M(\text{FREESTREAM}) = 10.1-25.1$

M. A. S. MINUCCI (Centro Tecnico Aeroespacial, Instituto de Estudos Avancados, Sao Jose dos Campos, Brazil) and H. T. NAGAMATSU (Rensselaer Polytechnic Institute, Troy, NY) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 3, May-June 1992, p. 680-686. Previously cited in issue 06, p. 754, Accession no. A90-19681. refs

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A92-36979* National Aeronautics and Space Administration, Langley Research Center, Hampton, VA.

NUMERICAL STUDY OF THE EFFECTS OF REVERSE SWEEP ON SCRAMJET INLET PERFORMANCE

AJAY KUMAR (NASA, Langley Research Center, Hampton, VA), D. J. SINGH (Analytical Services and Materials, Inc., Hampton, VA), and CARL A. TREXLER (NASA, Langley Research Center, Hampton, VA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 3, May-June 1992, p. 714-719. Previously cited in issue 19, p. 2977, Accession no. A90-42749. refs

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A92-37389

NEW MODEL FOR PREDICTING END WALL BOUNDARY LAYER IN AN AXIAL CASCADE

HU WU, FUQUN CHEN, and SONGLING LIU (Northwestern Polytechnical University, Xian, People's Republic of China) Northwestern Polytechnical University, Journal (ISSN 1000-2758), vol. 10, no. 2, April 1992, p. 133-139. In Chinese. refs

Attention is given to a new model for predicting the end wall boundary layer in an axial cascade which can predict the end wall boundary layer and the blade force defect more accurately than previous models and is applicable to both the case of tip clearance and the case of no tip clearance. Detailed theoretical analysis, which explains the new model for the blade force defect, is presented. The analysis considers the development of both primary flow and transverse flow in the end wall boundary layer. The governing equations of 3D and wall boundary layer in a physical plane and a detailed expression of the blade force defect are derived. A revised expression of entrainment is put forward. An explanation of the significant effect of tip clearance on the end wall boundary layer and blade force defect is offered. P.D.

A92-37537* National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, TX.

COMPUTATIONAL METHODS FOR SHOCK WAVES IN THREE-DIMENSIONAL SUPERSONIC FLOW

CHIH-PENG LI (NASA, Johnson Space Center, Houston, TX) (Symposium on Recent Developments in Large-Scale Computational Fluid Dynamics, Minneapolis, MN, Apr. 23, 24, 1990, Technical Papers. A92-37530 15-34) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 87, no. 2-3,

June 1991, p. 305-327. refs
Copyright

A central artificial-viscosity and an upwind-biased difference method are contrived to solve the Euler equations for flowfields over typical spacecrafts. The spatial discretization is based on either nodal or cell-vertex formulation in the domain extending from free stream to the end of the vehicle. The outer boundary is treated as a bow shock in the first method but is placed in the free stream in the second, which captures both bow and internal shocks using an approximate Riemann solver based on high-order extrapolation to the cell face. These methods were tested for the Shuttle and Hermes orbiters at wind-tunnel conditions and angles of attack ranging from 0 to 60 deg. The artificial-viscosity method incorporated with a shock-fitting procedure shows smeared crossflow and wing-shock positions and required 15 percent more CPU per node than the upwind method. Greater flexibility and robustness is demonstrated by the latter on a fixed grid for all cases considered. Author

A92-37539* National Aeronautics and Space Administration, Washington, DC.

THE COMPUTATION OF THREE-DIMENSIONAL FLOWS USING UNSTRUCTURED GRIDS

K. MORGAN, J. PERAIRE, J. PEIRO (Imperial College of Science, Technology, and Medicine, London, England), and O. HASSAN (Swansea, University College, Wales) (Symposium on Recent Developments in Large-Scale Computational Fluid Dynamics, Minneapolis, MN, Apr. 23, 24, 1990, Technical Papers. A92-37530 15-34) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 87, no. 2-3, June 1991, p. 335-352. refs (Contract NAGW-1809)

Copyright

A general method is described for automatically discretizing, into unstructured assemblies of tetrahedra, the three-dimensional solution domains of complex shape which are of interest in practical computational aerodynamics. An algorithm for the solution of the compressible Euler equations which can be implemented on such general unstructured tetrahedral grids is described. This is an explicit cell-vertex scheme which follows a general Taylor-Galerkin philosophy. The approach is employed to compute a transonic inviscid flow over a standard wing and the results are shown to compare favorably with experimental observations. As a more practical demonstration, the method is then applied to the analysis of inviscid flow over a complete modern fighter configuration. The effect of using mesh adaptivity is illustrated when the method is applied to the solution of high speed flow in an engine inlet.

Author

A92-37549 NUMERICAL SIMULATION OF HYPERSONIC VISCOUS FLOW FOR THE DESIGN OF H-II ORBITING PLANE (HOPE)

YUKIMITSU YAMAMOTO (National Aerospace Laboratory, Chofu, Japan) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 89, no. 1-3, Aug. 1991, p. 59-72. refs

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An unmanned winged vehicle for space transportation called H-II orbiting plane (HOPE) is being studied by the National Space Development Agency of Japan (NASDA). CFD analyses have been performed for HOPE 62A, 62B, 62C, and HOPE 63 models proposed by NASDA. Through these analyses, more than 50 numerical test cases have been calculated and aerodynamic and aerothermodynamic characteristics are investigated in detail. In the study, numerical simulations have been done by using a flux split upwind Navier-Stokes code. The results showed excellent agreements with experiments for aerodynamic stability and heat transfer distributions and the validity of the present code is demonstrated. Author

A92-37550

AN EXPLORATION OF CHEMICALLY REACTING VISCOUS HYPERSONIC FLOW

JOHN ARGYRIS, IOANNIS ST. DOLTSINIS, HEINZ FRIZ, and JUERGEN URBAN (Stuttgart, Universitaet, Federal Republic of Germany) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 89, no. 1-3, Aug. 1991, p. 85-128. refs

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In continuation of the research and development work at the ICA in the field of hypersonic reentry flows, the paper deals with the consideration of real gas effects and in particular with the description of mass transfer in chemically reacting flow. Previous work in this field was concerned with the numerical simulation of Euler flow with an extension to nonequilibrium chemistry and to nonreacting viscous hypersonic flow. The present account starts with an investigation of the numerical scheme for the time integration of the chemical kinetics and discusses its interaction with the temporal development of the flow field. The extension of the method to the viscous reactive case is straightforward from the computational point of view, but the complexity of the physical models for the mass transport introduces major difficulties. Both issues are discussed from the fundamental point of view and the experience on numerical examples. Author

A92-37551

NON-EQUILIBRIUM HYPERSONIC FLOW SIMULATIONS USING THE SECOND-ORDER BOUNDARY LAYER EQUATIONS

M. L. SAWLEY and S. WUETHRICH (Lausanne, Ecole Polytechnique Federale, Switzerland) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 89, no. 1-3, Aug. 1991, p. 129-140. Research supported by Dassault Aviation and Commission Suisse pour l'Encouragement de la Recherche Scientifique. refs

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A coupled Euler/boundary layer method to calculate hypersonic reentry flows in chemical nonequilibrium is described. The flow is divided into two regions, with the second-order boundary layer equations being applied in the inner (viscous) region and the Euler equations in the outer (inviscid) region. It is shown that this allows a good matching of the calculated profiles at the interface between the two regions. The inclusion of second-order effects is shown not only to modify significantly the calculated boundary layer profiles, but also to have a large influence on the computed surface coefficients. Author

A92-37552* National Aeronautics and Space Administration, Langley Research Center, Hampton, VA.

A NEW FINITE ELEMENT FORMULATION FOR COMPUTATIONAL FLUID DYNAMICS. X - THE COMPRESSIBLE EULER AND NAVIER-STOKES EQUATIONS

FARZIN SHAKIB (Centric Engineering Systems, Inc., Palo Alto, CA), THOMAS J. R. HUGHES, and ZDENEK JOHAN (Stanford University, CA) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 89, no. 1-3, Aug. 1991, p. 141-219. Research supported by Dassault Aviation. refs

(Contract NAG1-361)

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A space-time element method is presented for solving the compressible Euler and Navier-Stokes equations. The proposed formulation includes the variational equation, predictor multi-corrector algorithms and boundary conditions. The variational equation is based on the time-discontinuous Galerkin method, in which the physical entropy variables are employed. A least-squares operator and a discontinuity-capturing operator are added, resulting

in a high-order accurate and unconditionally stable method. Implicit/explicit predictor multi-corrector algorithms, applicable to steady as well as unsteady problems, are presented; techniques are developed to enhance their efficiency. Implementation of boundary conditions is addressed; in particular, a technique is introduced to satisfy nonlinear essential boundary conditions, and a consistent method is presented to calculate boundary fluxes. Numerical results are presented to demonstrate the performance of the method. Author

A92-37553

PERFORMANCE OF TURBULENCE MODELS TO PREDICT SUPERSONIC BOUNDARY LAYER FLOWS

F. HANINE and A. KOURTA (Toulouse, Institut de Mecanique des Fluides, France) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 89, no. 1-3, Aug. 1991, p. 221-235. refs
Copyright

The predictions of near-wall compressible flows with turbulence models are evaluated by means of a test case with attention given to the impact of the compressibility effect. The k-omega-squared model by Wilcox and Rubesin (1980) is examined because of its applicability to compressible flows, and the model is compared to k-epsilon models that do not account for compressibility. Another version of the second-order model is employed to analyze the behavior of the anisotropy near the wall under the compressibility effects. The second-order and the Wilcox-Rubesin model are shown to perform better than the first-order models for the calculation of the supersonic flat-plate boundary layer. The results are further improved by using a correction by Nichols (1990) and a compressibility correction by Vandromme (1983) in the formulation of the model by Chien (1982). The results demonstrate that compressibility does not significantly modify the principal characteristics of boundary-layer flows. C.C.S.

A92-37554

AN INFORMATION SYSTEM FOR THE NUMERICAL SIMULATION OF 3D EULER FLOWS AROUND AIRCRAFT

J. W. BOERSTOEL and S. P. SPEKREYSE (National Aerospace Laboratory, Amsterdam, Netherlands) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 89, no. 1-3, Aug. 1991, p. 237-257. refs
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A flow-simulation system is described with attention given to its application to the study of complex 3D aerodynamic configurations using multiblock-grid generation. The numerical flow-simulation system is based on five subtasks: block subdivision, grid generation, numerical flow simulation, graphical inspection, and method managing. The grid-generation function is described generically for constructing the multiblock grid emphasizing block decomposition, the ability to treat compound edges and faces, and the use of parametric functions for face-surface geometries. Transfinite interpolation is used to develop a grid-generation method for block faces, and the Dirichlet/Neumann boundary-value problem for grid-control functions can be treated without grid folding. The fundamental mathematical algorithm and the methods for multiblock-grid generation are expected to provide accurate simulations of flows about aircraft. C.C.S.

A92-37933

A NOTE ON THE KUTTA CONDITION IN GLAUERT'S SOLUTION OF THE THIN AEROFOIL PROBLEM

S. W. RIENSTRA (Eindhoven University of Technology, Netherlands) Journal of Engineering Mathematics (ISSN 0022-0833), vol. 26, no. 1, Feb. 1992, p. 61-69. refs
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Glauert's classical solution of the thin aerofoil problem (a coordinate transformation, and splitting the solution into a sum of

a singular part and an assumed regular part written as a Fourier sine series) is usually presented in textbooks on aerodynamics without a great deal of attention being paid to the role of the Kutta condition. Sometimes the solution is merely stated, apparently satisfying the Kutta condition automatically. Quite often, however, it is misleadingly suggested that it is by the choice of a sine series that the Kutta condition is satisfied. It is shown here that if Glauert's approach is interpreted in the context of generalized functions: (1) the whole solution, i.e., both the singular part and any non-Kutta condition solution, can be written as a sine series; and (2) it is really the coordinate transformation which compels the Kutta condition to be satisfied, as it enhances the edge singularities from integrable to nonintegrable, and so sifts out solutions not normally representable by a Fourier series. Furthermore, the present method provides a very direct way to construct other, more singular solutions. A practical consequence is that (at least, in principle) in numerical solutions based on Glauert's method, more is needed for the Kutta condition than a sine series expansion. Author

A92-38269

SOLUTION OF EULER EQUATIONS FOR FIGHTER FOREBODY-INLET COMBINATIONS AT HIGH ANGLES OF ATTACK

XIAOQING ZHENG and HUILI SHEN (Northwestern Polytechnical University, Xian, People's Republic of China) IN: Aerospace - Collected translations of selected papers (A92-38266 15-01). Xian, People's Republic of China, Northwestern Polytechnical University, 1991, 11 p. Translation. Research supported by Ministry of Aero Space Industry. Previously cited in issue 15, p. 2289, Accession no. A90-36419. refs

A92-38270

AERODYNAMIC ANALYSIS AND MODIFICATION DESIGN OF NPU AIRFOILS

JUN HUA, ZHONGYIN ZHANG (Northwestern Polytechnical University, Xian, People's Republic of China), G. REDEKER, and G. WICHMANN (DLR, Institut fuer Entwurfsaerodynamik, Brunswick, Federal Republic of Germany) IN: Aerospace - Collected translations of selected papers (A92-38266 15-01). Xian, People's Republic of China, Northwestern Polytechnical University, 1991, 6 p. Translation. Previously cited in issue 20, p. 3081, Accession no. A89-46295. refs

A92-38370* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

OBLIQUE SHOCK WAVE WITH SWEEP

G. EMANUEL (Oklahoma, University, Norman) Shock Waves (ISSN 0938-1287), vol. 2, no. 1, 1992, p. 13-18. refs
(Contract NAG1-886)

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An attached planar, oblique shock with sweep is investigated for the inviscid flow of a perfect gas. The ratio of specific heats, freestream Mach number, and wedge angle in the plane of the freestream velocity are prescribed, with the sweep angle as a free parameter. Explicit relations are provided for jump and detachment conditions. A number of trends, some nonintuitive, are discussed, e.g., the downstream Mach number may increase with sweep. Author

A92-38373

STAGNATION POINT HEAT FLUX IN HYPERSONIC HIGH ENTHALPY FLOW

S. L. GAI and N. R. MUDFORD (University College, Campbell, Australia) Shock Waves (ISSN 0938-1287), vol. 2, no. 1, 1992, p. 43-47. refs

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The paper describes stagnation point heat flux measurements at a range of enthalpies relevant to reentry speeds of aero-assisted space transfer vehicles (ASTVs) and proposed space planes, using the Australian National University Free Piston Shock Tunnel T3. The unique feature of these experiments is that they were

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conducted in the 'straight through' (reflectionless) mode which enabled higher enthalpies and densities hitherto unattained.

Author

A92-38456

AN IMPROVED ANALYSIS METHOD FOR CROSS-WIRE SIGNALS OBTAINED IN SUPERSONIC FLOW

J. F. DONOVAN (McDonnell Douglas Research Laboratories, Saint Louis, MO) and E. F. SPINA (Syracuse University, NY) Experiments in Fluids (ISSN 0723-4864), vol. 12, no. 6, April 1992, p. 359-368. refs

(Contract AF-AFOSR-88-0120)

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Four cross-wire analysis methods for supersonic flow are examined with the aim of improving the overall accuracy of the measurements. Three of the methods are small perturbation techniques, and the fourth solves the governing equations directly. The methods are compared using data for a turbulent boundary layer with free-stream Mach 2.86, and it is shown that the second-order method produces minimum errors. Although coefficient drift can cause large errors in the desired quantities, these errors can be reduced by carefully selecting the reduction method. V.L.

A92-38856

EFFECT OF CONTROLLED LONGITUDINAL VORTEX ARRAYS ON THE DEVELOPMENT OF A TURBULENT BOUNDARY LAYER

HIDEO OSAKA and CHIHARU FUKUSHIMA (Yamaguchi University, Ube, Japan) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 290-298. refs

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Measurement was made on the mean flowfield to investigate the development of a turbulent boundary layer interacting with controlled longitudinal vortex arrays that were artificially generated from tiny airfoils arranged side by side in the free stream. Five arrangements varying in spacing between neighboring airfoils and distance of airfoil arrays from the test wall were studied. Within the boundary layer, there is spanwise transport of streamwise momentum due to pairs of counterrotating secondary flows. As a result, a spanwise periodic variation corresponding to the spanwise arrangement of airfoil elements arises in the mean flowfield and persists in the far-downstream region. The spacing between neighboring airfoils leads to a significant effect on the streamwise path of longitudinal vortices, which significantly affect the magnitude of boundary layer distortion. Even in the present three-dimensional flowfield, the streamwise velocity profiles collapse reasonably well on the standard logarithmic law of the wall. However, the wake region of logarithmic profiles is different at representative spanwise locations. Author

A92-38858

FLOW REGIMES OF THE COVE REGIONS BETWEEN A SLAT AND WING AND BETWEEN A WING AND FLAP OF A MULTIELEMENT AIRFOIL

E. SAVORY, N. TOY, B. TAHOURI, and S. DALLEY (Surrey, University, Guildford, England) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 307-316. Research supported by SERC. refs

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An experimental study was made of the flow regimes associated with the cove regions of a multielement airfoil. These regions occur when the leading edge slats and trailing edge flaps on the wings are extended to generate high lift during takeoff and landing of the aircraft. The results include mean velocity and turbulence intensity data, measured between the slat and wing and between the wing and flap, together with comprehensive pressure

distributions around the three airfoil components. This information should be of value in the development of numerical models for predicting the flow around high-lift airfoils. Author

A92-38859

THE EFFECT OF A VELOCITY GRADIENT ON THE AERODYNAMIC FORCES OF A CIRCULAR CYLINDER WITH TANGENTIAL BLOWING

TSUTOMU HAYASHI and FUMIO YOSHINO (Tottori University, Japan) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 317-324. refs

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The lift and drag acting on a circular cylinder with tangential blowing immersed in a uniform shear flow are presented for a shear parameter $K = 0.15$ and Reynolds number $Re = 60,000$, and the effect of the velocity gradient of the uniform shear flow on characteristic values is discussed for coefficients of momentum of the blowing jet ranging from 0 to 0.4. The characteristic values include the angle and the pressure coefficient of the stagnation point, separation points, minimum pressure point, and base pressure. Consequently, the shear parameter in the two cases where the location of the blowing slot on the circular cylinder is on the cylinder surface on the faster side of the shear flow ($K +$) and on the slower side ($K -$) yields the difference of coefficients of lift and drag and different starting points for the forced reattachment phenomenon. A comparison of various features such as the stagnation point clarifies the contributions of each feature to the lift and drag on the cylinder. Author

A92-38860

REYNOLDS STRESS BUDGET IN THE OUTWASH JET ARISING FROM COLLIDING CURVED WALL JETS

S. O. PARK and H. S. REW (Korea Advanced Institute of Science and Technology, Taejeon, Republic of Korea) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 325-331. Research supported by Korea Science and Engineering Foundation and Korea Advanced Institute of Science and Technology. refs

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Various Reynolds stress budgets in an outwash jet resulting from the collision of two curved wall jets are experimentally investigated. The outwash jet is initially accelerating until the two detached jets become fully merged. Later, the merged jet develops to obtain similarity. The Reynolds stress budgets in the interacting region (where the jet is accelerating) and those in the similar region have been carefully evaluated on the basis of measurements with hot-wire anemometry. The reported budgets include the kinetic energy budget, the longitudinal normal stress budget, the lateral normal stress budget, and the shear stress budget, which are rarely found elsewhere. Author

A92-38861

REYNOLDS STRESS DISTRIBUTION DOWNSTREAM OF A TURBINE CASCADE

ANTONIO PERDICHIZZI (Brescia, Università, Italy), MARINA UBALDI, and PIETRO ZUNINO (Genova, Università, Genova, Italy) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 338-350. refs

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Results of an experimental investigation of three-dimensional turbulent flow developing downstream of a turbine cascade (aspect ratio, 1.05; flow turning, 84 deg) are reported for four planes located respectively at 10, 30, 54, and 90 percent of an axial chord downstream of the blade trailing edge. The main features of the mean flowfield evolution are the mixing process occurring in the wake, mutual interaction of the secondary vortices, and the decay

of the secondary kinetic energy. The Reynolds stress distributions are found to be consistent with the complicated nature of the mean motion. V.L.

A92-38863

EXPERIMENTS ON TURBULENT FLOW DUE TO AN ENCLOSED ROTATING DISK

MOTOYUKI ITOH, YUTAKA YAMADA, SHIGEKI IMAO, and MASAHIRO GONDA (Nagoya Institute of Technology, Japan) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 359-368. refs Copyright

An experimental study is undertaken on the turbulent flow due to an enclosed rotating disk. Measurements of the mean velocity distributions and all six components of Reynolds stress are made for the two boundary layers developed on the rotating disk (rotor) and the stationary end wall (stator). It is revealed that the velocity distributions in the respective boundary layers show a similarity at constant local Reynolds number $Re_{sub} L$. A log-law region where the circumferential velocity profile follows the logarithmic law for the flat-plate boundary layer is observed at high $Re_{sub} L$ values. All the components of Reynolds stress normalized by the friction velocity are larger inside the stator-side boundary layer than in the rotor-side boundary layer. The directions of the shear stress vectors are found not to coincide with the directions of the velocity gradient vectors. Author

A92-38906

A STUDY OF FLOW PATTERNS AND BEHAVIOURS OF 3D SEPARATED FLOW ON A SIMPLIFIED SHUTTLE MODEL

XUEYING DENG and HONGWEI ZHANG (Beijing University of Aeronautics and Astronautics, People's Republic of China) Acta Aerodynamica Sinica (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 21-30. In Chinese. refs

An investigation of low-speed separated flow patterns on a simplified Space Shuttle model has been carried out at angles of attack from 0 to 50 deg. Six flow patterns appear on the upper surface of the wing and four appear on the body. A new type of 3D separated flow pattern appears on the body in which the 3D separation line starts at the saddle point in the surface skin friction vector field, while the line has not inaccessible behavior. The open/close separation behaviors are discussed in detail, and it is found that those pertaining to the new type of 3D separation are similar to those of close separation in nature. C.D.

A92-38907

SEPARATED FLOW OVER THE PROTUBERANCES IN HYPERSONIC FLOW

SUXUN LI, YUEDING SHI, and HANLONG CAI (Beijing Institute of Aerodynamics, People's Republic of China) Acta Aerodynamica Sinica (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 31-37. In Chinese. refs

Hypersonic flow over 3D low protuberances is studied in a hypersonic wind tunnel with free-stream Mach number of 5 and Reynolds number of $2.6-6.0 \times 10^6/m$. The ratio of protuberance height to boundary layer thickness is 0.5-0.8 and the oblique angles at round edges can be changed. The pressure distributions along the model center lines and special positions are measured and visualization are made, including schlieren graph in space and oil flow patterns on the wall. These show the flow field of the shock wave/boundary layer interaction and the separated flow regions. The positions of maximum and minimum distances between the separation lines and models are found, and the maximum pressure ratio at the center line is determined. C.D.

A92-38908

HYPERSONIC TURBULENT SEPARATED FLOW PAST AN UNSWEPT CIRCULAR CYLINDER ON A FLAT PLATE

SHIFEN WANG and QINGQUAN LI (Chinese Academy of Sciences,

Institute of Mechanics, Beijing, People's Republic of China) Acta Aerodynamica Sinica (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 38-44. In Chinese. refs

This paper presents features of wall pressure and heat transfer and the characteristic parameters of separation shock motion on the centerline upstream of an unswept circular cylinder. The results show that there is secondary separation on the centerline upstream of the unswept circular cylinder. The characteristic double-peaked mean wall pressure distribution exists. The distribution of mean surface heat transfer is a little different from it and shows an approximate plateau region. Both distributive shapes are similar in the initial upstream influence region of the separation shock and in the vicinity of the cylinder leading edge. The centerline length of the upstream influence region of the separation shock and the pressure and heat transfer peaks increase with increasing free stream Mach number. The separation shock structure is unsteady and undergoes large-scale low-frequency motion. C.D.

A92-38909

PREDICTION FOR THE INCIPIENT SEPARATION OF FIN-GENERATED THREE-DIMENSIONAL SHOCK WAVE TURBULENT BOUNDARY LAYER INTERACTIONS

HUASHU DOU and XUEYING DENG (Beijing University of Aeronautics and Astronautics, People's Republic of China) Acta Aerodynamica Sinica (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 45-52. In Chinese. refs

The incipient separation induced by shock-wave/turbulent-boundary-layer interactions at sharp fins was studied, and a method for predicting the incipient separation was developed based on the compressible boundary-layer theory. In the analysis Johnston's triangle model was employed in the boundary layer, and the Prandtl-Meyer function was used in the external flow outside the boundary layer. A comparison between theory and experimental data in references is carried out, and good agreement is achieved. Author

A92-38910

DELAY OF WING VORTEX BURSTING BY USING FAVORABLE INTERACTION OF VORTICES

YANAN FENG, XUEJIAN XIA, XIAOFENG LIU, and RIZHI LIU (Beijing University of Aeronautics and Astronautics, People's Republic of China) Acta Aerodynamica Sinica (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 53-59. In Chinese. refs

An experimental investigation aimed at delaying wing vortex bursting for fighter and missile-type wing-body combinations was performed using flow visualizations and force measurements. The experimental models had wings with sharp leading edges, body strakes with high sweepback and small areas fixed to both sides of the bodies. A fighter-type model had a delta body strake with 70 deg sweepback angle, 10.2 percent exposed wing span and 2.2 percent exposed wing area. The resulting flow patterns indicate that vortex bursting of the wing for the model with body strake is efficiently delayed. Longitudinal force and moment data illustrate that body strake can increase the maximum lift coefficient and the critical angle of attack. The drag coefficient has an increment in the presence of body strake. When the range of angle of attack is less than 10 deg the lift-drag ratio is decreased, but when it exceeds 10 deg body strake essentially has no effect on lift-drag ratio. C.D.

A92-38913

A FLOW VISUALIZATION EXPERIMENT ON THE UNSTEADY FLOW AROUND TWO-DIMENSIONAL AIRFOIL

XINTIAN YU, GUANGMING FU, ERJIE CUI, SHUYUAN WANG, and NING ZHAO (Beijing Institute of Aerodynamics, People's Republic of China) Acta Aerodynamica Sinica (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 76-80. In Chinese. refs

A flow-visualization experiment is performed in a water channel. By exerting mechanical excitations - such as flap and rotating leading edge - on the flowfield around a 2D airfoil at high angle-of-attack, the unsteady flow effects are isolated and studied. The experimental results show that the mechanical excitation adopted can strongly affect the separating flow around the stalled

airfoil at high angles of attack. It clearly reveals the physical mechanism of experimental results obtained earlier in a wind tunnel and shows a way for researching the high-lift-efficient effects due to the unsteady flows. Author

A92-38916

EXPERIMENTAL INVESTIGATION ON REDUCING FLUCTUATING PRESSURES OF LAUNCH VEHICLES BY PASSIVE SHOCK-WAVE/BOUNDARY-LAYER CONTROL

QIZHENG LU and BO LU (China Aerodynamics Research and Development Center, Mianyang, People's Republic of China) *Acta Aerodynamica Sinica* (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 98-103. In Chinese. refs

The effectiveness is studied of passive shock-wave/boundary-layer control on for reducing drag and fluctuating pressures on the surface of a launch model in a 0.6 m x 0.6 m transonic wind tunnel. With a porosity of 10 percent, the fluctuating pressure peak can be reduced by 50-70 percent, and when the free-stream Mach number is 0.95-0.98, the drag coefficient decreases by 5.5-7.83 percent with inclined holes. The effects of various parameters on the fluctuating pressures are demonstrated. The mechanism of passive shock wave/boundary-layer control using schlieren photographs and power spectral analyses of the fluctuating pressures is discussed. C.D.

A92-38917

MEASUREMENT AND ANALYSIS OF THE FLOW FIELD ABOVE A WING/BODY CONFIGURATION

ZHIYONG LU, HONGYU LU, YIDONG LI, and ZHILI YANG (Beijing University of Aeronautics and Astronautics, People's Republic of China) *Acta Aerodynamica Sinica* (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 104-110. In Chinese. refs

Wind tunnel measurement results from a flow field above the wing/body configuration with a double delta wing are introduced. The leading edge swept angle of the inner and outer wing for the double delta wing were 70 deg and 50 deg, respectively. Reynolds number was about 320,000. The results show that the flow patterns can be attributed to the wing leading edge vortex, the body vortex, the broken-down vortex flow, and the full separation flow. The body vortex, which appears at medium incidence, is induced by the wing vortex with the same rotation sense. There is a viscous interference regime with low energy near the wing-body junction which increases with larger incidence. When the burst point of the wing vortex approaches the apex of the exposed wing, the dimension of the low-energy flow is 5-8 times larger than the body diameter near the wing trailing edge. C.D.

A92-38918

THE NUMERICAL SIMULATION OF TRANSONIC INVISCID FLOW OVER OSCILLATING AIRFOILS

FENG LI, YIYUN WANG, and ERJIE CUI (Beijing Institute of Aerodynamics, People's Republic of China) *Acta Aerodynamica Sinica* (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 111-116. In Chinese. refs

The dynamic process is numerically simulated on 2D airfoils oscillating sinusoidally. The Euler equations are required to solve with the implicit factored finite-difference algorithm. Numerical results of NACA0012 and NACA64A010 airfoils are presented, some of which agree with experimental data. Some unsteady effects are investigated with the numerical simulation. Author

A92-38919

NUMERICAL SIMULATION OF SEPARATION FLOW ON BODIES OF REVOLUTION AT HIGH ANGLE OF ATTACK USING EULER EQUATIONS

MINGKE HUANG (Nanjing Aeronautical Institute, People's Republic of China) *Acta Aerodynamica Sinica* (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 117-122. In Chinese. refs

A 3D Euler code has been used to compute compressible flow over bodies of revolution at high angles of attack. No separation is found when the free stream is subsonic, a finding opposed to what happens in practice. Thus, the normal force

computed on the body is much less than that found experimentally because the vortex lift due to separation is not considered. On the other hand, when the free stream is supersonic and the cross-flow Mach number is high enough, computations using the Euler equations can easily capture the separation vortex due to shock-induced separation on the leeward side of the body. In this case, the value of the computed normal force on the body is close to the experimental one. To capture the separation vortex using Euler equations for the subsonic free stream, it is suggested that a forced Kutta condition be applied to one or two lines near the assumed separation line on the body surface. C.D.

A92-38920

A CALCULATION OF INFLUENCE OF VORTEX BREAKDOWN ON AERODYNAMIC CHARACTERISTICS FOR SLENDER WINGS

SHANWEN XIONG and WEIPING SONG (Beijing University of Aeronautics and Astronautics, People's Republic of China) *Acta Aerodynamica Sinica* (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 123-129. In Chinese. refs

Based on Brown and Michael's vortex model for slender wings the influence of vortex breakdown on the aerodynamic characteristics of slender wings is simulated by distributing sources along the vortex axes. The calculation for a set of slender wings having various planforms indicates that the variation of the aerodynamic characteristics around the stall angle of attack calculated by the present method is qualitatively in good agreement with that of the actual wings. Author

A92-38924

THE NUMERICAL SIMULATION OF SEPARATION CONTROL USING MOVING SURFACE EFFECT

FENG LI, YIYUN WANG, and ERJIE CUI (Beijing Institute of Aerodynamics, People's Republic of China) *Acta Aerodynamica Sinica* (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 146-150. In Chinese. refs

Separation control on Joukowski airfoils with leading-edge rotational cylinders is investigated by numerical simulation. An implicit finite-difference algorithm is employed to solve the 2D compressible Navier-Stokes equations on a body-fitted curvilinear coordinate system. Numerical results indicate that with such a leading-edge device aerodynamic lift force can be augmented and separation size can be decreased. Author

A92-38925

NUMERICAL SIMULATION OF INTERACTION BETWEEN VORTEXES AND SHOCKS IN JET FLOW FIELD

HANDONG MA, WEIJIANG ZHOU, and FENG LI (Beijing Institute of Aerodynamics, People's Republic of China) *Acta Aerodynamica Sinica* (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 151-155. In Chinese. refs

The supersonic flow on plate with transverse jet is solved with the fully 2D Navier-Stokes equations with CSCM scheme. It allows consideration of flow separation, vortices, shocks and possible interactions with one another. Under the sparse computational grid, the flowfield of simulation is comparatively clear with the structure of shocks and main vortices. The results are also compared with experiment and other computations. The study shows that the CSCM scheme provides good vortex-capturing capability. Author

A92-39333*

National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

BOUNDARY-LAYER RECEPTIVITY DUE TO A WALL SUCTION AND CONTROL OF TOLLMIE-SCHLICHTING WAVES

R. J. BODONYI (Ohio State University, Columbus) and P. W. DUCK (Manchester, Victoria University, England) *Physics of Fluids A* (ISSN 0899-8213), vol. 4, no. 6, June 1992, p. 1206-1214. Previously announced in STAR as N92-10009. refs (Contract NAS1-18605)

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A numerical study of the generation of Tollmien-Schlichting (T-S) waves due to the interaction between a small free-stream

disturbance and a small localized suction slot on an otherwise flat surface was carried out using finite difference methods. The nonlinear steady flow is of the viscous-inviscid interactive type while the unsteady disturbed flow is assumed to be governed by the Navier-Stokes equations linearized about this flow. Numerical solutions illustrate the growth or decay of T-S waves generated by the interaction between the free-stream disturbance and the suction slot, depending on the value of the scaled Strouhal number. An important result of this receptivity problem is the numerical determination of the amplitude of the T-S waves and the demonstration of the possible active control of the growth of T-S waves. Author

A92-39338

LAMINAR FLOW CONTROL OF SUBSONIC BOUNDARY LAYERS BY SUCTION AND HEAT TRANSFER STRIPS

J. A. MASAD and A. H. NAYFEH (Virginia Polytechnic Institute and State University, Blacksburg) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 6, June 1992, p. 1259-1272. refs (Contract N00014-91-J-1309) Copyright

The effects of suction and heat-transfer strips on the stability of subsonic boundary layers over flat plates are investigated analytically and experimentally. A scheme for the design of optimal suction-strip configurations is proposed. It is shown that an improperly placed cooling strip may have a destabilizing rather than stabilizing effect. It is also shown that, although heating destabilizes air boundary layers, a properly placed heating strip can stabilize them. V.L.

A92-39340* National Aeronautics and Space Administration, Langley Research Center, Hampton, VA.

BEHAVIOR OF ASYMMETRIC UNSTABLE MODES OF A TRAILING LINE VORTEX NEAR THE UPPER NEUTRAL CURVE

MEHDI R. KHORRAMI (High Technology Corp., Hampton, VA) Physics of Fluids A (ISSN 0899-8213), vol. 4, no. 6, June 1992, p. 1310-1313. refs (Contract NAS1-18240) Copyright

The linear stability of a trailing line vortex subjected to disturbances having azimuthal wave number $n = -1$ is considered. In the limit of large Reynolds numbers, the corresponding inviscid solution for this wave number is obtained. It is found that near the upper neutral curve, there exists mode crossing and mode switching between the primary and secondary modes. It is also found that viscous forces have both stabilizing and destabilizing effects on inviscid modes, which result in the appearance of a second peak in the growth rate curves. Author

A92-39934

MIXED VOLUME BOUNDARY ELEMENT APPROACH FOR AERODYNAMICS

MAURICIO P. BRANDAO (Instituto Tecnológico de Aeronautica, Sao Jose dos Campos, Brazil) (Mechanics Pan-America 1991; Pan-American Congress of Applied Mechanics, 2nd /PACAM II/, Valparaiso, Chile, Jan. 2-5, 1991, Selected and Revised Proceedings. A92-39930 16-31) Applied Mechanics Reviews (ISSN 0003-6900), vol. 44, no. 11, pt. 2, Nov. 1991, p. S36-S45. Research supported by Ministerio da Aeronautica of Brazil, CNPq, and FAPESP. refs Copyright

A formation is developed for the analysis of 3D, unsteady, and viscous flows. The surface terms are treated following the traditional boundary element method with special care taken in revealing the hidden singularities of curved surfaces. A computational procedure is presented to determine simultaneously the velocity and pressure fields around bodies moving in compressible and incompressible fluids. R.E.P.

A92-39940

PANEL METHOD CONTROL IN 3-D HYPERBOLIC GRID GENERATION

M. H. L. HOUNJET (National Aerospace Laboratory, Amsterdam, Netherlands) (Mechanics Pan-America 1991; Pan-American Congress of Applied Mechanics, 2nd /PACAM II/, Valparaiso, Chile, Jan. 2-5, 1991, Selected and Revised Proceedings. A92-39930 16-31) Applied Mechanics Reviews (ISSN 0003-6900), vol. 44, no. 11, pt. 2, Nov. 1991, p. S121-S129. Research supported by Netherlands Agency for Aerospace Programs. refs Copyright

A method is presented for the generation of OH type grids about transport type aircraft. The method combines a hyperbolic grid generation scheme with source terms obtained with a panel method in such a way that OH type grids around fairly complex shapes with concavities can be generated easily. The components of the method: a method to generate grids with a panel method and the hyperbolic grid generation scheme, will be described and applications will be shown. Author

A92-39941

KNOWLEDGE-BASED NONLINEAR BOUNDARY INTEGRAL MODELS OF COMPRESSIBLE VISCOUS FLOWS OVER ARBITRARY BODIES - TAKING CFD BACK TO BASICS

BARRY HUNT (GE Aircrafts Engines, Cincinnati, OH) (Mechanics Pan-America 1991; Pan-American Congress of Applied Mechanics, 2nd /PACAM II/, Valparaiso, Chile, Jan. 2-5, 1991, Selected and Revised Proceedings. A92-39930 16-31) Applied Mechanics Reviews (ISSN 0003-6900), vol. 44, no. 11, pt. 2, Nov. 1991, p. S130-S142. refs Copyright

The paper starts with a discussion of a knowledge-based CFD methodology. A new incompressible formulation known as SAVER is first introduced, employing a novel relaxation approach. This is then generalized through a modification of the boundary conditions to the GENESIS methodology, for analysis or design in compressible, rotational flow. A discussion is presented of how the basic causal nature of integral methods offers new insights into certain flow phenomena, such as shocks and separations, and facilitates aerodynamic sensitivity analysis. The paper presents a new class of vector fields approximating the Euler equations for transonic flows, and shows how GENESIS can be used to construct first an exact solution of these approximate fields, then a numerical solution of the residual error fields. The explicit representation of a shock discontinuity on the body boundary exploits its causal link with conditions at the sonic point to suppress, nondissipatively, the mathematically-valid but physically-impossible formation of an expansion shock. Author

A92-39949

INTEGRAL EQUATION METHODS FOR LINEAR AND NONLINEAR AERODYNAMICS

E. C. YATES, JR. (Mechanics Pan-America 1991; Pan-American Congress of Applied Mechanics, 2nd /PACAM II/, Valparaiso, Chile, Jan. 2-5, 1991, Selected and Revised Proceedings. A92-39930 16-31) Applied Mechanics Reviews (ISSN 0003-6900), vol. 44, no. 11, pt. 2, Nov. 1991, p. S285-S294. refs Copyright

This paper reviews the NASA Langley Research Center program for development of integral-equation aerodynamic methods with emphasis on application in computed-aided multidisciplinary design processes as well as in aerodynamic design and stand-alone analysis. The accomplishments, status, and outlook of the program are discussed in order to highlight the scope, generality, versatility, and attractive features of this methodology, especially for application to nonlinear problems. Author

A92-39964* National Aeronautics and Space Administration, Langley Research Center, Hampton, VA.

ANALYSIS FOR THE APPLICATION OF HYBRID LAMINAR FLOW CONTROL TO A LONG-RANGE SUBSONIC TRANSPORT AIRCRAFT

P. C. ARCARA, JR., D. W. BARTLETT (NASA, Langley Research Center, Hampton, VA), and L. A. MCCULLERS (Vigyan, Inc., Hampton, VA) SAE, Aerospace Technology Conference and

02 AERODYNAMICS

Exposition, Long Beach, CA, Sept. 23-26, 1991. 17 p. refs
(SAE PAPER 912113) Copyright

The FLOPS aircraft conceptual design/analysis code has been used to evaluate the effects of incorporating hybrid laminar flow control (HLFC) in a 300-passenger, 6500 n. mi. range, twin-engine subsonic transport aircraft. The baseline configuration was sized to account for 50 percent chord laminar flow on the wing upper surface as well as both surfaces of the empennage airfoils. Attention is given to the additional benefits of achieving various degrees of laminar flow on the engine nacelles, and the horsepower extraction and initial weight and cost increments entailed by the HLFC system. The sensitivity of the results obtained to fuel-price and off-design range are also noted. O.C.

A92-39965* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

APPLICATION OF LAMINAR FLOW CONTROL TO HIGH-BYPASS-RATIO TURBOFAN ENGINE NACELLES

Y. S. WIE (High Technology Corp., Hampton, VA), F. S. COLLIER, JR., and R. D. WAGNER (NASA, Langley Research Center, Hampton, VA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 12 p. refs
(Contract NAS1-18240)
(SAE PAPER 912114) Copyright

Recently, the concept of the application of hybrid laminar flow to modern commercial transport aircraft was successfully flight tested on a Boeing 757 aircraft. In this limited demonstration, in which only part of the upper surface of the swept wing was designed for the attainment of laminar flow, significant local drag reduction was measured. This paper addresses the potential application of this technology to laminarize the external surface of large, modern turbofan engine nacelles which may comprise as much as 5-10 percent of the total wetted area of future commercial transports. A hybrid-laminar-flow-control (HLFC) pressure distribution is specified and the corresponding nacelle geometry is computed utilizing a predictor/corrector design method. Linear stability calculations are conducted to provide predictions of the extent of the laminar boundary layer. Performance studies are presented to determine potential benefits in terms of reduced fuel consumption. Author

A92-39967* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

APPLICATION OF LINEAR STABILITY THEORY IN LAMINAR FLOW DESIGN

VENKIT IYER (Vigyan, Inc., Hampton, VA) and ROBERT SPALL (High Technology Corp., Hampton, VA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 18 p. refs
(Contract NAS1-18585; NAS1-18240)
(SAE PAPER 912116) Copyright

The linear stability of fully three-dimensional supersonic boundary layers formed over swept-wing configurations is investigated using a modified version of the linear stability code COSAL. Configurations studied include a highly swept leading-edge model to be utilized for transition studies in the LARC Low-disturbance Mach 3.5 Pilot Tunnel. The model is a representation of the leading edge of a laminar flow control wing for the F-16XL aircraft. In addition, the region over a laminar flow control glove fitted on the midportion of an F-16XL wing was studied. For each configuration, estimates of the location of the onset of transition were computed using linear stability theory and the e^{6N} method. The effectiveness of suction in stabilizing the boundary layer over the F-16XL wing glove was also investigated. Author

A92-39973 NON LINEAR INDUCED DRAG STUDY OF GENERICALLY CAMBERED CLOSELY COUPLED DUAL WINGS

DOUG BLAKE (USAF, Washington, DC) and BRUCE P. SELBERG (Missouri-Rolla, University, Rolla) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991.

10 p. refs

(SAE PAPER 912126) Copyright

The variations in maximum wing camber and maximum camber location for dual-wing systems are presently ascertained by means of a nonlinear vortex-lattice method having both spanwise and chordwise panels. Both the flat-wake and rollup-wake results thus obtained indicate that the upper wing must have more camber than the lower, in order to minimize induced drag; the lowest induced-drag results were obtained when the position of maximum camber for the lower wing was at 30 percent of chord. The position of maximum camber for the lower wing could be tailored from 10 to as much as 70 percent while maintaining low induced drag. O.C.

A92-39974

COMPUTATIONAL ANALYSIS OF DRAG REDUCTION TECHNIQUES FOR AFTERBODY/NOZZLE/EMPENNAGE CONFIGURATIONS

WILLIAM T. JONES (Dynamic Engineering, Inc., Newport News, VA) and KHALED S. ABDOL-HAMID (Analytical Services and Materials, Inc., Hampton, VA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 30 p. refs

(SAE PAPER 912127) Copyright

Three-dimensional Navier-Stokes solutions were obtained for the external flow around three single-engine body-empennage configurations using the PAB3D code. These solutions were used to study afterbody drag-reduction techniques. The configurations were solved at Mach 0.6 and a 0-deg angle of attack and consisted of the following: (1) a baseline case for which experimental data was available; (2) a contoured modification based on the area rule; and (3) elliptic cross section modifications designed to take advantage of the favorable pressures in the tail-stagnation regions. The area rule modification resulted in a 6.3-percent reduction in afterbody/nozzle drag and an 8.5-percent decrease in total aft-end drag. While the afterbody/nozzle drag for the elliptic cross section case showed a 15.4-percent decrease from the baseline, the increased pressure drag of the tails resulted in a net decrease of only 1.1 percent for the body-empennage configuration. Author

A92-39975

SCALE MODEL TEST OF AN ISOLATED TURBOFAN NACELLE WITH RIBLETS

N. O. STOCKMAN, M. O. LATAPY, T. L. ANDREW, and D. H. ROGERS, JR. (GE Aircraft Engines, Cincinnati, OH) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 15 p. refs
(SAE PAPER 912128) Copyright

A one-seventh scale model of a high bypass turbofan inlet/nacelle was tested with and without V-groove riblets applied to the external surface. Tests were conducted in the French ONERA S1 transonic atmospheric wind tunnel in Modane. Before the test was finished riblets came off in two places and other problems with the riblets arose. These problems were partially solved by selective use of the drag data. Drag reductions up to 6.4 percent, depending on flow conditions, were obtained. Locally, reductions up to 8 percent were attained. In general, the higher drag reductions were attained when shocks were present. Author

A92-39976

SOME PRACTICAL ASPECTS OF VISCOUS DRAG REDUCTION CONCEPTS

FRANK T. LYNCH and MARK D. KLINGE (Douglas Aircraft Co., Long Beach, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 14 p. refs
(SAE PAPER 912129) Copyright

The practical issues that need to be resolved before an in-service application of either riblets or hybrid laminar flow control (HLFC) can be realistically considered. The major challenge faced by riblets is to demonstrate that they can be viable economically by showing a payback to airlines in no more than two years. Steps that need to be taken to demonstrate economic viability are suggested. For HLFC, the most important needs are to provide

a practical and effective wing ice protection system, demonstrate that HLFC can be effectively used in the wing root area and some other areas, devise a means of overcoming performance deficiencies and risks incurred by the requirement to use a Krueger-type leading edge device instead of a slat, and develop wing-tunnel testing techniques. These objectives have to be accomplished without resorting to a full-up prototype program prior to launching production aircraft. C.D.

A92-39986

CFD CALCULATIONS OF CLOSELY COUPLED SCISSOR WINGS - INVISCID, VISCOUS, AND VORTEX LATTICE WITH ROLLUP RESULTS

CLARENCE CHENAULT (USAF, Washington, DC) and BRUCE P. SELBERG (Missouri-Rolla, University, Rolla) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 10 p. refs (SAE PAPER 912150) Copyright

2D and 3D studies were conducted with dual wings having NACA 64A-006 airfoil sections at geometries that simulate the scissor wing configuration for low speed applications. For a geometric placement between the two wings of $X = 1.0$, $G = 0.20$, and $D = -2$ deg, the dual airfoils had lower 2D drag than the single airfoil. A 19 percent chord single front flap deflected at 2 deg on the upper airfoil for a dual airfoil combination with $X = 1.0$, $G = 0.25$, and $D = 0$ deg was able to duplicate the improved aerodynamic characteristics found for the nonflap $S = 1.0$, $G = 0.20$, and $D = -2$ deg cases. However, forward flap placement and deflection were very sensitive to boundary layer transition at the flap hinge point. Simple rear flaps on the lower airfoil were able to duplicate the dual airfoil combination of $S = 1.0$, $G = 0.20$, and $D = -2$ deg. The 3D induced drag results with wake rollup demonstrated only small improvements in induced drag over the single wing. C.D.

A92-39988 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

PASSIVE CONTROL OF SUPERSONIC CAVITY FLOWFIELDS

N. CHOKANI and I. KIM (North Carolina State University, Raleigh) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 13 p. Research supported by North Carolina Board of Science and Technology. refs (Contract NCC1-46; NAGW-1072) (SAE PAPER 912153) Copyright

A computational investigation has been conducted to study the effect and mechanisms of the passive control of a supersonic flow over a rectangular two-dimensional cavity. The passive control was included through the use of a porous surface over a vent chamber in the floor of the cavity. The passive control effectively suppressed the low-frequency pressure oscillations for the open type cavity, (length-to-depth ratio = 6.0). The mechanism for the suppression was observed to be the stabilization of the motion of the free shear layer. For the closed type cavity flow, (length-to-depth ratio = 17.5), the passive control modified the flowfield to nearly that of an open type cavity flow; further the cavity drag was reduced by a factor of four. The computational results of both cases showed good agreement with the available experimental data and the predictions of a semiempirical formula. This study demonstrates that the passive control concept can be used to improve the aerodynamic characteristics of open and closed cavity flowfields. Author

A92-40055

BURSTS AND SOURCES OF PRESSURE FLUCTUATION IN TURBULENT BOUNDARY LAYERS

J. F. MORRISON (GEC Alsthom Turbine Generators, Ltd., Aerodynamics Group, Manchester, England) and P. BRADSHAW (Stanford University, CA) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 2-1-1 to 2-1-6. Research supported by U.S. Army. refs

A four-wire array in a flat-plate, zero-pressure-gradient turbulent

boundary layer is used to make low-wave-number measurements of the spanwise components of the quantities which appear as source terms in Poisson's equation for the pressure fluctuation. These source terms, referred to as 'splat' and 'spin', are analyzed by use of the VITA-LEVEL conditional sampling scheme and the results are correlated with the local wall pressure. The results show that the period between successive ejections and sweeps, and the period between successive splats and/or spins both scale with viscous variables (not with wall variables), suggesting that high-wave-number pressure fluctuations trigger the bursting sequence. Author

A92-40056

THREE-DIMENSIONAL VORTICAL STRUCTURE OF A LARGE-SCALE COHERENT VORTEX IN A TURBULENT BOUNDARY LAYER

H. MAKITA and K. SASSA (Toyoashi University of Technology, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 2-2-1 to 2-2-6. refs

The streamwise evolution of three-dimensional structure of an artificially induced vortex was pursued by measuring velocity and vorticity fields through a simplified conditional sampling. The artificial vortex developed downstream through the growth, the self-preserving and the decay stages. In the growth stage, the vortex grew up to have a horseshoe sculpture and the vorticity confined in it was increased downstream. The grown-up large-scale horseshoe vortex reached about 1.2 delta in height, 1.0 delta in width, and 5.0 delta in streamwise length. The vortex became more inclined forward and lost the ability of maintaining its self-similar construction in the decay stage. The convection velocity of the vortex's head was 0.56 $U(\infty)$ in the foregoing two stages and was raised to 0.85 $U(\infty)$ in the decay stage. Author

A92-40059* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

EVOLUTION OF THREE-DIMENSIONALITY IN STABLE AND UNSTABLE CURVED MIXING LAYERS

MICHAEL W. PLESNIAK, RABINDRA D. MEHTA, and JAMES P. JOHNSTON (Stanford University, CA) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 3-2-1 to 3-2-6. refs (Contract NSF CTS-88-15670; NCC2-55)

Results are presented of an experimental study tracing the effects of mild streamwise curvature (δ/R is less than 5 percent) on the 3D structure of a two-stream mixing layer at high Reynolds number (about 27,000). Measurements of the mean and fluctuating velocities were obtained on fine cross-plane grids at 11 streamwise locations using a rotatable cross-wide probe. Well-organized streamwise vorticity was generated in both cases through the braid instability. Although the vortex structures decayed with streamwise distance in both cases, the rate of decay for the unstable case was lower. As a result, the unstable layer exhibited noticeable spanwise variations in the mean velocity and Reynolds stresses. Both cases achieved linear growth, but the rate of growth for the unstable case was higher. The far-field spanwise-averaged peak Reynolds stresses were significantly higher for the destabilized case compared to the stabilized case, which exhibited levels comparable to those of a straight case. C.A.B.

A92-40063

A NEW METHOD FOR VISUALIZATION AND MEASUREMENT OF TURBULENT FLOW PATTERNS

R. H. G. MUELLER (Forschungsinstitut fuer Bildverarbeitung, Umwelttechnik und Stroemungsmechanik, Duesseldorf, Federal Republic of Germany) and M. HACKESCHMIDT (Hochschule fuer Verkehrswesen, Dresden, Federal Republic of Germany) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1.

University Park, PA, Pennsylvania State University, 1991, p. 4-1-1 to 4-1-6. refs

The study presents a novel flow visualization method which can be applied to very complex airflows, including turbulent shear flows and burst vortices. Thin and sharp-edged smoke lines are placed within the flow region under consideration by projecting small burning pellets through the flow. The smoke traces behave like time lines and can be photographed using multiflash photography. The flow velocities can be determined by measuring the displacement of the traces between adjacent flashes. Flow photographs are presented which show turbulent shear flows with a spatial resolution of less than 1 mm and flow velocities of up to 20 m/s. The method's advantage is the Lagrangian view of the flow together with the possibility to produce quantitative results.

C.A.B.

A92-40068

ON THE MECHANICS OF 3-D TURBULENT BOUNDARY LAYERS

OLAV SENDSTAD and PARVIZ MOIN (Stanford University, CA) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 5-4-1 to 5-4-5. Research supported by USAF. refs

The effect of an impulsively started transverse pressure gradient on turbulence structures in a planar channel flow was studied using direct numerical simulation. In agreement with experiments, the simulation shows a reduction in the Reynolds shear stress. It also shows a drop in the turbulent kinetic energy. These effects were found to be related to the break-up of the near-wall velocity streaks. The streamwise vortices are convected in the spanwise direction, breaking the original streak structures as they cross over them. It was also found that the vortices with the same sign as the developing mean streamwise vorticity were weakened.

Author

A92-40081

TURBULENT ENERGY BUDGETS IN IMPINGING ZONES

J. M. M. BARATA, D. F. G. DURAO, and M. V. HEITOR (Lisboa, Universidade Tecnica, Lisbon, Portugal) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 8-3-1 to 8-3-6. Abridged.

The study presents budgets of turbulent kinetic energy in the vicinity of the stagnation zone created by the impingement of a turbulent jet on a flat plate through a low-velocity crossflow. The analysis is based on laser-Doppler measurements of the time-resolved velocity field, which were carried out for a velocity ratio between the jet and the crossflow of 30, for a Reynolds number based on the jet exit conditions of 60,000 and for an impinging distance of 5 jet-diameters, and provide a basis for a better understanding of several related but more complex practical flowfields. The results quantify the time-averaged vortex structure developed in this type of flows, as well as the decrease of the Reynolds stresses in the region of strong (stabilizing) curvature, which characterizes the impinging zone, followed by their fast increase before finally decreasing. The nature of the turbulent transport of Reynolds stresses is analyzed, and the related implications for the calculation of complex turbulent flows is discussed.

C.A.B.

A92-40084

FAR-FIELD TURBULENCE STRUCTURE OF THE TIP VORTEX SHED BY A SINGLE RECTANGULAR WING

WILLIAM J. DEVENPORT and GAUTAM SHARMA (Virginia Polytechnic Institute and State University, Blacksburg) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 9-1-1 to 9-1-6. refs

The tip vortex shed by a single rectangular NACA 0012 wing is being studied. Helium bubble flow visualizations and extensive hot-wire velocity measurements have been performed over a wide

range of conditions with the intent of revealing the far-field turbulence structure of this flow. At all conditions the vortex appears insensitive to probe interference and relatively stable. Some very low frequency lateral motions are present but these have an amplitude of less than ± 5 percent of the wing chord. These motions dominate turbulence measurements made close to the vortex center. Away from the center the effects of the motions are much smaller, however, and the true turbulence structure is visible. This is dominated by the wing wake which forms a spiral around the core.

Author

A92-40085

LDV MEASUREMENTS IN THE UNSTEADY TIP-VORTEX BEHIND AN OSCILLATING RECTANGULAR WING

YOUXIN ZHENG and B. R. RAMAPRIAN (Washington State University, Pullman) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 9-2-1 to 9-2-6. refs
(Contract DAAL03-87-G-0011; DAAL03-91-G-0026; AF-AFOSR-90-0131)

A92-40086

PHASE-AVERAGED TURBULENCE STATISTICS IN A NEAR WAKE WITH AN ASYMMETRIC VORTEX SHEDDING

A. NAKAYAMA (Kobe University, Japan), H. R. RAHAI, and H. UNT (California State University, Long Beach) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 9-3-1 to 9-3-6. refs

The turbulent near wake of a two-dimensional body influenced by a vortex shedding due to a fixed separation on one side has been measured by a direction-sensitive multicomponent split-film probe and the flow characteristics were studied in terms of the phase-averaged statistics of the turbulent velocity components. The contributions to the total apparent shear stress from the periodic motion and the random fluctuation are comparable in one case, but the phase-averaged Reynolds shear stress is fairly well described by a positive eddy viscosity.

Author

A92-40087

AN EXPERIMENTAL EVALUATION OF SOME TURBULENCE MODELS FROM A THREE-DIMENSIONAL TURBULENT BOUNDARY LAYER AROUND A WING-BODY JUNCTION

SEMIH M. OLCMEN and ROGER L. SIMPSON (Virginia Polytechnic Institute and State University, Blacksburg) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 9-4-1 to 9-4-6. refs

A92-40104

VORTICAL FLOW SIMULATION BY THE SOLUTION OF THE NAVIER-STOKES EQUATIONS

J. M. A. LONGO and R. RADESPIEL (DLR, Institut fuer Entwurfsaerodynamik, Braunschweig, Federal Republic of Germany) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 13-4-1 to 13-4-6. refs

The validation of a finite-volume scheme for the solution of the 3D Navier-Stokes equations for the prediction of vortical flowfields around delta and strake-delta wings is presented. The current technique is based on central difference approximations (cell-vertex formulation) with a Runge Kutta integration in time. Using local time stepping, implicit residual smoothing, a multigrid method and carefully controlled artificial dissipative terms, the convergence rates are dramatically improved for the complex flow problems tested. The reliability of the present scheme for engineering applications is established by comparing the numerical results with wind tunnel measurements at subsonic and transonic speeds.

Author

A92-40105* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A STUDY OF THREE DIMENSIONAL TURBULENT BOUNDARY LAYER SEPARATION AND VORTEX FLOW CONTROL USING THE REDUCED NAVIER STOKES EQUATIONS

BERNHARD H. ANDERSON (NASA, Lewis Research Center, Cleveland, OH) and SAEED FAROKHI (Kansas, University, Lawrence) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 13-5-1 to 13-5-6. Previously announced in STAR as N91-23089. refs

A reduced Navier-Stokes (RNS) initial value space marching solution technique was applied to vortex generator and separated flow problems and demonstrated good predictions of the engine face flow field. This RNS solution technique using FLARE approximations can adequately describe the topological and topographical structure flow separation associated with vortex liftoff, and this conclusion led to the concept of a subclass of separations which can be called vorticity separations: separations dominated by the transport of vorticity. Adequate near wall resolution of vorticity separations appears necessary for good predictions of these flows. Author

A92-40106

AN EXPERIMENTAL AND NUMERICAL STUDY OF CONFINED AXISYMMETRIC JET WITH A BLUFF BODY

M. SENDA, S. OKAMOTO, and S. KIKKAWA (Doshisha University, Kyoto, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 14-1-1 to 14-1-6. refs

Results are reported from experimental and numerical studies conducted on a confined axisymmetric jet with two types of bluff bodies - a cylindrical ring and a disk, both of which have the same blockage ratio. The velocity characteristics in the near wake are measured with a laser Doppler velocimeter, the results of which are compared with the numerical calculations using the k-epsilon model of turbulence. The size of the recirculating region behind the ring was not affected by the velocity ratio U_j/U_s of the jet and the circumferential flows, whereas both the axial and radial extent of the recirculating region behind the disk became larger with increasing U_j/U_s . In the near-wake region, the positions where the values of the mean axial velocity gradient and the Reynolds shear stress were respectively at zero did not necessarily coincide, and the present flow indicates the existence of the region of the negative production. C.A.B.

A92-40111

THE NATURAL AND FORCED FORMATION OF SPOT-LIKE LAMBDA-STRUCTURES CAUSED BY VORTEX DISLOCATIONS IN A WAKE

C. H. K. WILLIAMSON (Cornell University, Ithaca, NY) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 15-1-1 to 15-1-6. refs
(Contract N00014-90-J-1686)

The 3D transition of the flow behind a bluff body, at low Reynolds numbers, is studied. It is shown that the wake transition involves, in addition to the two fundamental modes of 3D vortex shedding in the wake of a circular cylinder, the appearance of LF intermittent wake oscillations, which are the result of the generation of large-scale 'spotlike' structures that grow downstream to a size of the order of 10-20 primary wavelengths. These massive structures, which are caused by 'vortex dislocations', have some similarities with turbulent spots found in bounded shear flows, as well as with some flow structures found in free shear flows. It is also shown that such spotlike structures can be passively forced to occur in the wake using a small localized disturbance near the body. The disturbance causes the period generation of 'vortex dislocations' that grow into the large-scale 'spots'. Forcing such

phenomena makes it possible to effectively study their structure and characteristics. C.A.B.

A92-40119

SCRUTINIZING K-EPSILON EVM AND ASM BY MEANS OF LES AND WIND TUNNEL FOR FLOWFIELD AROUND CUBE

S. MURAKAMI, A. MOCHIDA, and Y. HAYASHI (Tokyo, University, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 17-1-1 to 17-1-6. refs

A92-40121

EMBEDDED LONGITUDINAL VORTEX ARRAYS, VELOCITY AND TEMPERATURE FIELDS, LOSS AND HEAT TRANSFER AUGMENTATION

M. FIEBIG, J. X. ZHU, and N. K. MITRA (Bochum, Ruhr-Universitaet, Federal Republic of Germany) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 17-3-1 to 17-3-5. refs

Turbulent flows in the entrance of a parallel wall channel with mounted longitudinal vortex generator in form of delta wing, rectangular wing, delta winglet pair, and rectangular winglet pair are simulated by the numerical solution of the Reynolds averaged Navier-Stokes, energy and standard k-epsilon model equations. Results show that the heat transfer augmentation of 16 percent to 19 percent occurs in an area of channel wall which is 30 times larger than the vortex generator area. The ratio of heat transfer enhancement and flow loss increase indicates better performance for the rectangular winglet pair. Author

A92-40125

TRANSITION TO TURBULENCE IN CURVED CHANNEL FLOW

O. J. E. MATSSON (Royal Institute of Technology, Stockholm, Sweden), ALESSANDRO BOTTARO (Lausanne, Ecole Polytechnique Federale, Switzerland), and P. H. ALFREDSSON (Royal Institute of Technology, Stockholm, Sweden) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 18-2-1 to 18-2-6. Research supported by STU. refs

Experiments and numerical simulations have been carried out for the developing flow in a curved channel. This flow is susceptible to a centrifugal instability, which results in the formation of streamwise oriented vortices. Linear stability theory is able to accurately predict the critical Reynolds number, i.e., the Reynolds number for which the primary instability starts to develop. If the Reynolds number is increased above the critical a number of supercritical bifurcations occurs before a developed turbulent state is reached. The focus here is on the initial stages of transition to turbulence of the flow from its original laminar state. Our measurements and simulations show that even at Reynolds numbers six times the critical one the longitudinal vortex structure persists. Author

A92-40126

EVOLUTION OF COHERENT STRUCTURES DURING TRANSITION IN A FLAT-PLATE BOUNDARY LAYER

D. REMPFER (Stuttgart, Universitaet, Federal Republic of Germany) and H. FASEL (Arizona, University, Tucson) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 18-3-1 to 18-3-6. Research supported by U.S. Navy. refs

The coherent structures of the flow were calculated from the data of a numerical simulation by Rist et al. (1991) and the spatio-temporal behavior of these structures was investigated. The coherent structures were determined using the proper orthogonal decomposition technique leading to an expansion of the flow field variables into Karhunen-Loeve (KL) eigenfunctions. This decomposition was performed in planes normal to the flow direction and in three dimensions. In the 2D case, in addition to the

eigenfunctions for the velocity vector the eigenmodes of nonlinear functionals like turbulent production and viscous dissipation were calculated. The 3D KL eigenfunctions are demonstrated to represent the structures seen in experiments. Author

A92-40127

INFLUENCE OF SUCTION THROUGH A SLOT ON A TURBULENT BOUNDARY LAYER

G. PAILHAS, J. COUSTEIX (ONERA, Centre d'Etudes et de Recherches de Toulouse, France), F. ANSELMET, and L. FULACHIER (Institut de Mecanique Statistique de la Turbulence, Marseille, France) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 18-4-1 to 18-4-6. refs

The goal of the study is to analyze the effects of slot suction on a turbulent boundary layer and the relaxation of the flow downstream of the slots. The present study is also devoted to the understanding of the bursting phenomenon occurring in a boundary layer the turbulence of which is manipulated by localized suction. Two experiments are presented. One of them, in a water tunnel, is concerned with visualizations and measurements of mainly mean velocity with laser Doppler anemometry. The other one is carried out in a wind tunnel, by means of hot wire anemometry, with one or several slots, in order to mostly determine the influence of suction on velocity fluctuations and their correlation. A spectral analysis has also been made. In order to educe the general effect of suction on the coherent structures, a conditional analysis has been performed. Author

A92-40128

EXPERIMENTAL AND NUMERICAL INVESTIGATION OF A TURBULENT BOUNDARY LAYER OVER RIBBLETS

M. BENHALILOU, F. ANSELMET, J. LIANDRAT, and L. FULACHIER (Institut de Mecanique Statistique de la Turbulence, Marseille, France) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 18-5-1 to 18-5-6. Research supported by Service Technique des Programmes Aeronautiques. refs

The effect of triangular riblets on a turbulent boundary layer is investigated both experimentally and numerically. Measurements are performed in a water tunnel with laser-Doppler velocimetry extending within the grooves: mean values and Reynolds stresses relative to the longitudinal and spanwise velocity components are presented. Numerical predictions, assuming that the mean spanwise velocity is zero, are developed with a mixing length model. Author

A92-40134* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

SIMULATION AND MODELING OF HOMOGENEOUS COMPRESSIBLE TURBULENCE UNDER ISOTROPIC MEAN COMPRESSION

G. N. COLEMAN and N. N. MANSOUR (NASA, Ames Research Center, Moffett Field, CA) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 21-3-1 to 21-3-6. Research supported by U.S. National Research Council. refs

Compressible homogeneous turbulence subjected to isotropic mean compression is simulated numerically for high and low turbulent Mach numbers, at various compression rates. It is found that at low Mach numbers, the effects of viscosity variations on the development of the turbulent kinetic energy can be significant. A model consistent with the invariance of the Navier-Stokes equations to spherical compression, that takes into account variable viscosity effects is proposed. At high Mach numbers, the distribution of energy between the acoustic and solenoid fields is found to depend upon initial conditions. The simulation results are also used to evaluate two-equation compressible turbulence models. Author

A92-40140

COMPRESSIBILITY EFFECTS IN TURBULENT FAR WAKES

J. P. BONNET, J. DELVILLE, S. SAPIN (Poitiers, Universite, France), P. SULLIVAN (Clarkson University, Potsdam, NY), and R. YERU (Poitiers, Universite, France) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 23-1-1 to 23-1-6. Research supported by CNRS and NSF. refs

An experimental investigation of the Mach number effects in two-dimensional far wakes is presented. Three regimes are studied: subsonic (Mach 0.1), Mach 2.0 and Mach 4.2, in the developed part of the initially turbulent wakes. Hot wire anemometry is used to give one point statistics and conventional space-time correlations (STC). It is shown that, like in boundary layers, the intermittent part of the wakes are of less transversal extent in the supersonic cases. The spectra are strongly modified in the vicinity of the axis. The scales and the shapes of the STC are also quite sensitive to the Mach number. The supersonic wake seems to be more strongly structured than the equivalent subsonic one, with slight differences between Mach 2 and 4. Author

A92-40143

THE EFFECTS OF VISCOSITY AND DIFFUSION ON A SUPERSONIC MIXING LAYER

P. VUILLERMOZ (SEP, Vernon, France) and E. S. ORAN (U.S. Navy, Naval Research Laboratory, Washington, DC) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 23-4-1 to 23-4-6. Research supported by U.S. Navy and SEP. refs

Time-dependent two-dimensional numerical simulations of high-speed, compressible, confined, temporally evolving supersonic mixing layers between hydrogen and oxygen gas streams are used to examine the differences between Euler and Navier-Stokes solutions and the effects of convective Mach number. The computations show that the Euler solutions are reasonably accurate in the convective-mixing stage of the flow, when large-scale structures dominate. As the convective Mach number increases, the mixing and turbulent levels are reduced. Author

A92-40171 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

OSCILLATING AIRFOIL VELOCITY FIELD DURING LARGE AMPLITUDE DYNAMIC STALL

M. S. CHANDRASEKHARA and R. D. VAN DYKEN (U.S. Navy-NASA Joint Institute of Aeronautics; U.S. Naval Postgraduate School, Monterey; NASA, Ames Research Center, Moffett Field, CA) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 1-3-1, 1-3-2. refs

The leading edge flowfield of an airfoil executing a sinusoidal oscillatory motion and experiencing dynamic stall under compressibility conditions has been studied using a two component LDV system. Phase averaged mean velocity measurements and some flow quantities derived from it are presented and discussed. The results indicate extremely large accelerations of the flow are present around the leading edge with mean velocity values 60 percent higher than and instantaneous velocities as large as 1.75 times the free stream velocity. The velocity profiles at certain locations over the airfoil resemble that of a wake. Author

A92-40173

THE CALCULATION OF A COMPRESSIBLE BOUNDARY LAYER PAST A POINTED BODY AND A DELTA WING

E. KRAUSE (Aachen, Rheinisch-Westfaelische Technische Hochschule, Federal Republic of Germany), T. V. POPLAVSKAIA, and V. N. VETLUTSKII (Rossiiskaia Akademiia Nauk, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, Russia) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2.

University Park, PA, Pennsylvania State University, 1991, p. 1-7-1, 1-7-2. refs

The three-dimensional compressible, laminar and turbulent boundary layers past a pointed body and a delta wing by supersonic gas flow at the angle of attack are studied. An implicit absolutely stable difference scheme for a solution of the boundary-layer equations is suggested. Laminar and turbulent boundary layers are calculated for the ogive-cylinder combinations and for the delta wings. The skin-friction coefficients and the Stanton numbers are compared with experimental data. Author

A92-40175

VORTEX INTERACTION IN THE WAKE BEHIND AN OSCILLATING AIRFOIL

K. MORIKAWA and H. GROENIG (Aachen, Rheinisch-Westfaelische Technische Hochschule, Federal Republic of Germany) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 1-12-1, 1-12-2. refs

Vortex interaction in the wake behind a NACA 0012 airfoil with pitching oscillation in unsteady flow is investigated. Two sets of experiments have been carried out: while the first one concentrates on the periodic quasi-steady state of the flow, the second one deals with its starting stage. From the flow visualization by the dye injection method, the wake is classified into six types, depending on the reduced frequency and amplitude. Phenomena of transition to turbulence and reorganization of the wake type was interpreted as a result of vortex interaction. Author

A92-40177

EFFECTS OF ATTACK ANGLE ON LEG PORTION OF THE HORSESHOE VORTEX AROUND THE IDEALIZED WING

T. SHIZAWA, S. HOMAMI (Tokyo, Science University, Japan), and M. YAMAMOTO (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 1-18-1, 1-18-2. refs

The mechanism of horseshoe vortex interaction with the 2D boundary layer is investigated, and the effects of the attack angle on the leg vortex are clarified. The diffusing processes were found to depend on the distribution of Reynolds stresses at the region between plate and wing. The vortex motion of the leg vortex is largely influenced by the attack angle. P.D.

A92-40180

THE COMBINED WAKE OF AN ARRAY OF OSCILLATING RIBBONS

D. E. PAREKH (McDonnell Douglas Research Laboratories, Saint Louis, MO) and P. PULVIN (Lausanne, Ecole Polytechnique Federale, Switzerland) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 11-15-1, 11-15-2. refs

This work considers the combined wake of an array of oscillating ribbons oriented parallel to a uniform flow. The characteristics of this wake are documented with flow visualization and hot-wire anemometry for various excitation frequencies and amplitudes. Author

A92-40182

ANALYSIS OF TURBULENCE MODELS FOR HYPERSONIC BOUNDARY LAYERS

B. AUPOIX and J. COUSTEIX (ONERA, Centre d'Etudes et de Recherches de Toulouse, France) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 111-2-1, 111-2-2.

The predictions of various turbulence models are compared for different compressible boundary layer experiments. Algebraic models seem to be superior in the wall region while transport

equations are required in the outer part of the boundary layer. A two-layer model is thus proposed to improve the prediction.

Author

A92-40391

1991-92 AHS TECHNICAL COMMITTEE HIGHLIGHTS - AERODYNAMICS

ROBERT MOFFITT (Sikorsky Aircraft, Stratford, CT) Vertiflite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 71-74. Copyright

Research made in helicopter aerodynamics during 1991-92 is reviewed. Emphasis is given to model rotor testing, a new flow visualization technique, tilt rotor studies, and CFD code development. C.D.

A92-40549

RECENT RESEARCH INTO THE AERODYNAMICS OF ASTOVL AIRCRAFT IN GROUND ENVIRONMENT

K. KNOWLES and D. BRAY (Royal Military College of Science, Shrivenham, England) (Royal Aeronautical Society, AeroTech 92, Seminar, Birmingham, England, Jan. 14-17, 1992) Institution of Mechanical Engineers, Proceedings, Part G - Journal of Aerospace Engineering (ISSN 0954-4100), vol. 205, no. G2, 1991, p. 123-131. Research supported by British Aerospace, PLC. refs Copyright

Some of the aerodynamic phenomena associated with jet-lift aircraft in ground effect are discussed, with particular attention paid to current studies on ASTOVL aircraft. The problems associated with jet-lift aircraft in ground effect (airframe airloads, ground erosion, ground crew safety, noise, and airframe acoustic fatigue) are related to a number of jet-flow phenomena which are briefly outlined. The problem of hot-gas-ingestion avoidance by the engine is examined. The particular problems of modelling the ground vortex formed by impinging jets in cross-flows are then described in light of the authors' experimental studies. Finally, the importance of the stochastic behavior of hot-gas-ingestion-related flow fields is highlighted. S.A.V.

A92-40580

BIFURCATION ANALYSIS OF AIRFOILS IN INCOMPRESSIBLE FLOW

J.-K. LIU and L.-C. ZHAO (Northwestern Polytechnical University, Xian, People's Republic of China) Journal of Sound and Vibration (ISSN 0022-460X), vol. 154, no. 1, April 8, 1992, p. 117-124. refs

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A harmonic balance method is used to analyze bifurcations of airfoils with nonlinear pitching stiffness in incompressible flow. The feasibility of the harmonic balance method is confirmed through the asymptotic expansion method and the averaging method. Stability characteristics obtained via four different methods, which include the harmonic balance, numerical integration, asymptotic expansion, and averaging methods, are the same. O.G.

A92-40598

THE LOW-TURBULENCE WIND TUNNEL AT TOHOKU UNIVERSITY

H. ITO, R. KOBAYASHI, and Y. KOHAMA (Tohoku University, Sendai, Japan) Aeronautical Journal (ISSN 0001-9240), vol. 96, no. 954, April 1992, p. 141-151. Research supported by MOESC. refs

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A general-purpose low-turbulence wind tunnel was constructed using the design method of Bradshaw. Sound-absorbent material was used in every four corners to decrease sound intensity produced by a fan. The longitudinal component of turbulence intensity at the center of the closed working section is less than 0.02 percent of the mean velocity in the speed range between 18 m/s and 53 m/s. The mean velocity variations across the working section are within ± 0.1 percent of the mean velocity. Performance measurements have been done at representative tunnel cross sections to clarify the behavior of flow in the tunnel. This work differs from previous studies in the sense that emphasis

is placed not only on velocity distributions, but also on turbulence intensity distribution at several cross sections of the tunnel. The critical Reynolds number for a flat plate at zero incidence, $Re(c) = 3.5 \times 10 \exp 6$, measured in a stream of the very low turbulence intensity of 0.016 percent, is larger than that reported by Schubauer and Skramstad. Author

A92-40599

IN-FLIGHT EVALUATION OF MACH NUMBER AT HYPERSONIC SPEEDS

E. N. BRAILSFORD Aeronautical Journal (ISSN 0001-9240), vol. 96, no. 954, April 1992, p. 152-156. refs
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The prime need to know Mach number in flight is likely to be for the efficient operation and control of air-breathing propulsion units. The errors incurred by the use of the analytical expressions, which have been developed for supersonic flight, are quantified and shown to be increasingly serious for speeds in excess of $M =$ approximately 5.5. Systems for calculating this parameter in flight are reviewed and compared. It is shown that three out of the four systems identified are capable, potentially, of registering Mach number to a good precision. In each case, to achieve optimum precision requires a good knowledge of ambient air temperature. Such knowledge is likely to be available from meteorological satellites. Author

A92-40600

NUMERICAL PREDICTIONS OF TRANSONIC VISCOUS FLOWS AROUND AEROFOILS THROUGH AN EULER/BOUNDARY LAYER INTERACTION METHOD

D. P. COIRO, M. AMATO, and P. DE MATTEIS (Centro Italiano Ricerche Aerospaziali, Capua, Italy) Aeronautical Journal (ISSN 0001-9240), vol. 96, no. 954, April 1992, p. 157-165. refs
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A semiinverse viscous/inviscid coupling technique for the calculation of compressible flows is presented. Euler equations in integral form are solved for the inviscid part and integral compressible boundary-layer equations in direct and inverse form are solved for the viscous one. Interaction is realized using the equivalent sources approach. The technique has been applied to the calculation of the aerodynamic characteristics of aerofoils both in cruise and take-off or landing configurations. To treat the complex geometries involved in the latter case, a multiblock approach, based on structured 'H' grid topology, has been developed and validated for different configurations. Author

A92-40602

DESIGN OF WING PROFILES WITH TANGENTIAL SUCTION OR INJECTION [POSTROENIE KRYLOVYKH PROFILEI S TANGENTSIAL'NYM OTSOSOM ILI VDUVOM]

E. IU. ARISTOVA and A. V. POTASHEV Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1991, p. 8-11. In Russian. refs
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The problem of the design of a wing profile with tangential suction or injection is considered in the case where the sink (for suction) or the source (for injection) is located at a corner point in a slot at the airfoil surface. Velocity distribution in the neighborhood of the singular point is specified in analytical form. Examples of profiles generated during the numerical implementation of the solution on a computer are presented. V.L.

A92-40605

QUICK CALCULATION OF THREE-DIMENSIONAL SUPERSONIC FLOW PAST NEARLY AXISYMMETRIC BODIES [OPERATIVNYI RASCHET PROSTRANSTVENNOGO SVERKHZVUKOVOGO OBTEKANIYA TEL, BLIZKIKH K OSESIMMETRICHNOM]

V. I. TIMOSHENKO and V. P. GALINSKII Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1991, p. 22-27. In Russian. refs
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Results of calculations of three-dimensional supersonic flow past nearly axisymmetric bodies are presented to demonstrate the advantages of using a trigonometric approximation of the

circumferential derivatives over the traditional finite difference methods. The computation times for the two approaches are compared in relation to meridional planes used in the calculation. It is shown that the approach proposed here makes it possible to significantly reduce the number of planes required and thus reduce the computation time by a factor of 5-6 for angles of attack less than 2 deg and by a factor of 3 for angles of attack 2-5 deg in comparison with the finite difference method in the specific examples considered. V.L.

A92-40746

CALCULATION OF ROTATIONAL DERIVATIVES IN THE CASE OF LOCAL INTERACTION BETWEEN FLOW AND A BODY SURFACE [O RASCHETE VRASHCHATEL'NYKH PROIZVODNYKH PRI 'LOKAL'NOM' VZAIMODEISTVII POTOKA S POVERKHNOST'IU TELA]

A. I. BUNIMOVICH and A. V. DUBINSKII Prikladnaia Matematika i Mekhanika (ISSN 0032-8235), vol. 56, no. 1, Jan.-Feb. 1992, p. 52-57. In Russian. refs
Copyright

The problem of calculating the rotational derivatives of the force and moment characteristics of bodies of revolution moving at angle of attack is analyzed for the case of a low angular velocity. For a general class of models of local interaction between flow and a body surface, formulas are obtained for calculating the second-order rotational derivatives. V.L.

N92-24229*# Eloret Corp., Sunnyvale, CA.

DEVELOPMENT AND APPLICATION OF COMPUTATIONAL AEROTHERMODYNAMICS FLOWFIELD COMPUTER CODES Progress Report, 1 Oct. 1991 - 31 Mar. 1992

ETHIRAJ VENKATAPATHY 7 May 1992 146 p Original contains color illustrations
(NASA-CR-190294; NAS 1.26:190294) Avail: NTIS HC/MF A07; 5 functional color pages CSDL 01A

Presented is a collection of papers on research activities carried out during the funding period of October 1991 to March 1992. Topics covered include: blunt body flows in thermochemical equilibrium; thermochemical relaxation in high enthalpy nozzle flow; single expansion ramp nozzle simulations; lunar return aerobraking; line boundary problem for three dimensional grids; and unsteady shock induced combustion. H.A.

N92-24393# Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Geometrie und Praktische.

SIMULATION OF THE FLOW ON A SPACE GLIDER. STAGNATION POINT CALCULATION USING THE 2D NAVIER-STOKES EQUATIONS INCLUDING CHEMICAL EFFECTS [STROEMUNGSSIMULATION AN EINEM RAUMGLEITER. STAUPUNKTBERECHNUNG MITTELS DER 2D-NAVIER-STOKES-GLEICHUNGEN MIT CHEMIE]

S. MUELLER /n Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 p 109-110 Dec. 1990 In GERMAN
Avail: NTIS HC/MF A08

The flow at the nose of space gliders is numerically simulated. In a first phase only friction force, heat conduction, and diffusion are taken into account (Navier-Stokes equations). In the second phase, chemical effects such as dissociation and ionization are taken into account since at high Mach numbers very high temperatures occur. The one dimensional so-called ENO numerical simulation procedure is integrated in a two dimensional finite volume method. Friction force, diffusion, and heat conduction are approximated using a special interpolation technique. The chemical reactions are built in by an operator splitting. ESA

N92-24394# Technische Hochschule, Aachen (Germany, F.R.). Lehr- und Forschungsgebiet fuer Mechanik.

HYPERSONIC CONFIGURATIONS IN SLOW SPEED FLIGHT [HYPERSONISCHE KONFIGURATIONEN IM LANGSAMFLUG]

C.-A. MUELLER /n Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A

Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 p 111-112 Dec. 1990 In GERMAN
Avail: NTIS HC/MF A08

Theoretical methods for inviscid and compressible, stationary subsonic flows about hypersonic flight configurations are developed with a view to the design of such configurations. These are reliable numerical methods for the boundary layer calculation, for the prediction of flow separation, for the simulation of the produced free vortices, as well as for the prediction of the global aerodynamic behavior of the configuration. ESA

N92-24395# Technische Hochschule, Aachen (Germany, F.R.). Lehr- und Forschungsgebiet fuer Mechanik.

**SUPERSONIC FLOW IN COMPRESSION STAGES AND INLETS
[UEBERSCHALLSTROEMUNGEN IN VERDICHTERSTUFEN
UND EINLAEUFEN]**

I. GROTOWSKY In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 p 113-114 Dec. 1990 In GERMAN
Avail: NTIS HC/MF A08

Characteristic oriented calculation methods are developed for supersonic flows in compressors and inlet diffusers. The aim is to obtain design hints for the integration of inlets in hypersonic configurations and for channel geometries with possibly low loss delay of the supersonic flow in compressors and inlets using oblique shock systems. The high thermal loading in the corners of the inlet channels has to be analyzed and improved. A numerical bicharacteristics method for compressor with axial supersonic flow gives good approximate results, although for the calculation of multishock systems Godunov type procedures have to be used. ESA

N92-24680*# Maryland Univ., College Park.

**A STUDY OF VISCOUS INTERACTION EFFECTS ON
HYPersonic WAVERIDERS Ph.D. Thesis, Dec. 1991**

JINHWA CHANG Mar. 1992 216 p
(Contract NAG1-1192; RTOP 505-59-40-10)
(NASA-CR-189587; NAS 1.26:189587; UM-AERO-91-44) Avail:
NTIS HC/MF A10 CSCL 01A

The effects of viscous interaction in the analysis and design of improved classes of viscous optimized hypersonic waveriders is examined. The Corda computer program is used to generate viscous optimized hypersonic waveriders from conical flow fields without viscous interaction. Each waverider is optimized for maximum L/D, and comparison studies are made between cases with and without viscous interaction. The results show that aerodynamic performance of the viscous interaction waveriders are reduced due mainly to a large increase in skin-friction drag associated with the viscous interaction phenomena that grows with increasing Mach number and altitude, but some of this performance loss can be recouped by including viscous interactions within the optimization procedure. When the waverider is optimized for viscous interaction, the shape can change dramatically. A significant result of the present work delineates on a velocity-altitude map the region where viscous interaction effects are significant for modern hypersonic waveriders by performing parametric runs to produce L/D, C sub L, and C sub D contour plots for Mach numbers from 6 to 30 at altitudes from 30 to 80 km. Author

N92-24681*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**AN INCREMENTAL STRATEGY FOR CALCULATING
CONSISTENT DISCRETE CFD SENSITIVITY DERIVATIVES**

VAMSHI MOHAN KORIVI, ARTHUR C. TAYLOR, III, PERRY A. NEWMAN, GENE W. HOU (Old Dominion Univ., Norfolk, VA.), and HENRY E. JONES Feb. 1992 34 p
(Contract RTOP 505-59-53-01)

(NASA-TM-104207; NAS 1.15:104207; AVSCOM-TR-92-B-006)
Avail: NTIS HC/MF A03 CSCL 01A

In this preliminary study involving advanced computational fluid dynamic (CFD) codes, an incremental formulation, also known as

the 'delta' or 'correction' form, is presented for solving the very large sparse systems of linear equations which are associated with aerodynamic sensitivity analysis. For typical problems in 2D, a direct solution method can be applied to these linear equations which are associated with aerodynamic sensitivity analysis. For typical problems in 2D, a direct solution method can be applied to these linear equations in either the standard or the incremental form, in which case the two are equivalent. Iterative methods appear to be needed for future 3D applications; however, because direct solver methods require much more computer memory than is currently available. Iterative methods for solving these equations in the standard form result in certain difficulties, such as ill-conditioning of the coefficient matrix, which can be overcome when these equations are cast in the incremental form; these and other benefits are discussed. The methodology is successfully implemented and tested in 2D using an upwind, cell-centered, finite volume formulation applied to the thin-layer Navier-Stokes equations. Results are presented for two laminar sample problems: (1) transonic flow through a double-throat nozzle; and (2) flow over an isolated airfoil. Author

N92-24803*# California Polytechnic State Univ., San Luis Obispo.

**A STUDY OF TRANSONIC AERODYNAMIC ANALYSIS
METHODS FOR USE WITH A HYPersonic AIRCRAFT
SYNTHESIS CODE**

DORAL R. SANDLIN and PAUL CHRISTOPHER DAVIS May 1992 122 p Original contains color illustrations
(Contract NCC2-660)
(NASA-CR-189854; NAS 1.26:189854) Avail: NTIS HC/MF A06;
10 functional color pages CSCL 01A

A means of performing routine transonic lift, drag, and moment analyses on hypersonic all-body and wing-body configurations were studied. The analysis method is to be used in conjunction with the Hypersonic Vehicle Optimization Code (HAVOC). A review of existing techniques is presented, after which three methods, chosen to represent a spectrum of capabilities, are tested and the results are compared with experimental data. The three methods consist of a wave drag code, a full potential code, and a Navier-Stokes code. The wave drag code, representing the empirical approach, has very fast CPU times, but very limited and sporadic results. The full potential code provides results which compare favorably to the wind tunnel data, but with a dramatic increase in computational time. Even more extreme is the Navier-Stokes code, which provides the most favorable and complete results, but with a very large turnaround time. The full potential code, TRANAIR, is used for additional analyses, because of the superior results it can provide over empirical and semi-empirical methods, and because of its automated grid generation. TRANAIR analyses include an all body hypersonic cruise configuration and an oblique flying wing supersonic transport. Author

N92-24849# Canadian Aeronautics and Space Inst., Montreal (Quebec). Aerodynamics Section.

**PROCEEDINGS OF THE 3RD CANADIAN SYMPOSIUM ON
AERODYNAMICS**

1991 461 p Symposium held in Toronto, Ontario, 20-21 Nov. 1991 Prepared in cooperation with National Research Council of Canada, Ottawa, Ontario
(CTN-92-60420) Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

The CASI Symposium on Aerodynamics was organized to provide a forum for aerodynamics specialists to meet, exchange ideas, and present their latest works. Major topics covered include: (1) computational fluid dynamics, (2) experimental aerodynamics, (3) aeroelastics, and (4) operational issues related to the aircraft design, aerodynamic performance, aerodynamic analysis, and experimental measurements of aerodynamic properties especially as they relate to aircraft design.

Author (CISTI)

N92-24850# Ecole Polytechnique, Montreal (Quebec). Groupe de Recherche MIAO.

PERIODIC EULER AND NAVIER-STOKES SOLUTIONS ABOUT OSCILLATING AIRFOILS

J. Y. TREPANIER, H. ZHANG, M. REGGIO, and M. PARASCHIVOIU /In CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 2-12 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

A methodology for solving the unsteady Euler and Navier-Stokes equations around oscillating airfoils is presented. The procedure is composed of a moving grid management algorithm and of a Lagrangian-Eulerian flow solver. Triangular elements have been used to achieve flexible grid movement and adaptation. The scheme for moving grids uses a generalized version of the approximate Riemann solver of Roe which satisfies in an intrinsic way the geometric conversion laws and on which a novel manner to add the viscous terms has been implemented. The methodology has been applied to simulate the flow around an oscillating NACA0012 airfoil. The method was shown to be well adapted to these computations, especially in the Euler case where grid adaptation resulted in a better resolution of the moving shock wave.
 Author (CISTI)

N92-24853# Ecole Polytechnique, Montreal (Quebec). Dept. of Mechanical Engineering.

NAVIER-STOKES SIMULATION OF DYNAMIC STALL ON A ROTATING AIRFOIL

KO-FOA TCHON and ION PARASCHIVOIU /In CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 45-56 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

In the present paper, the incompressible unsteady isothermal viscous flowfield around a moving airfoil is modeled by the two-dimensional time averaged Navier-Stokes equations expressed in a stream function - vorticity formulation and in a non-inertial frame of reference. Spatial discretization is achieved by the streamline upwind/Petrov-Galerkin finite element method. Temporal discretization is achieved by second order accurate finite differences. At each time step, a non-linear algebraic system is solved using a Newton method. To accelerate the computations, a fast conjugate gradient method with an incomplete triangular factorization preconditioning is used to solve the linearized Newton systems. The computational mesh is composed of a structured region of highly stretched quadrilateral elements in the vicinity of solid boundaries, an unstructured region of triangular elements elsewhere, and a layer of infinite elements surrounding the domain and projecting the external boundary to infinity. Preliminary computations were performed on a circular cylinder and a NACA 0018 airfoil in translation and rotation.
 Author (CISTI)

N92-24854# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

TVD FINITE-DIFFERENCE SOLUTIONS OF NONEQUILIBRIUM VIBRATIONALLY RELAXING AND CHEMICALLY REACTING GASEOUS FLOWS

C. P. T. GROTH and J. J. GOTTLIEB /In CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 57-80 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Partially decoupled total variation diminishing (TVD) finite difference schemes for the solution of the conservation laws governing two dimensional nonequilibrium vibrationally relaxing and chemically reacting flows of thermally perfect gaseous mixtures are presented. In these methods, the gas dynamic and the thermodynamic equations are partially decoupled by using a frozen flow approximation. Both sets of decoupled equations are then solved alternately in a lagged manner within a time marching procedure, thereby providing explicit coupling between the fluid conservation laws and the species concentration and vibrational energy equations. Both time-split semi-implicit and factored implicit flux-limited TVD upwind schemes are described. The semi-implicit

formulation is more appropriate for unsteady applications whereas the factored implicit form is useful for obtaining steady-state solutions. Extensions of Roe's approximate Riemann solvers, giving the eigenvalues and eigenvectors of the fully coupled systems, are used to evaluate the numerical flux functions. Additional modifications to the Riemann solutions are also described which ensure that the schemes are entropy satisfying. The proposed partially decoupled methods are shown to have several computational advantages over other loosely coupled and fully coupled techniques. Furthermore, numerical results for single, complex, and double Mach reflection flows, as well as corner expansion and blunt-body flows, using a five-species four temperature model for air demonstrate that the methods perform well over the entire thermodynamic regime, from equilibrium to nonequilibrium conditions on through to the frozen flow limit.
 Author (CISTI)

N92-24856# National Research Council of Canada, Ottawa (Ontario). Inst. for Aerospace Research.

AN ANALYSIS OF THE SIDEWALL BOUNDARY LAYER EFFECT IN TWO-DIMENSIONAL WIND TUNNEL TESTING

D. J. JONES and Y. Y. CHAN /In CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 94-106 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

The Institute for Aerospace Research 1.5 m by 1.5 m wind tunnel is operated in a 2D mode with a 0.38 m wide insert in the working section usually giving a width to chord ratio of about 1.5. Although sidewall boundary layer effects are alleviated to some extent by allowing for controlled suction on the walls surrounding the airfoil, it is shown in the present paper that a residual effect is still experienced in such a narrow facility. By carrying out a numerical analysis of the phenomena using an inviscid wing code coupled with a small crossflow boundary layer method, suggestions are made to overcome the sidewall boundary layer problem. The major sidewall interference remaining after applying suction appeared to come from the airfoil leading edge/sidewall interaction which caused the sidewall boundary layer to thin extensively as it approaches the airfoil. To achieve better 2D flow, small endplates will be fixed on the airfoil model at a spanwise location just far enough from the sidewalls to be outside the sidewall boundary layer. This arrangement should result in good 2D flow.
 Author (CISTI)

N92-24857# De Havilland Aircraft Co. of Canada Ltd., Ottawa (Ontario).

VORVISC: A VORTEX LATTICE METHOD WITH VISCOUS AND COMPRESSIBILITY CORRECTIONS FOR FULL AIRCRAFT CONFIGURATIONS INCLUDING PROPULSION

G. C. WALLER /In CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 125-142 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

VORVISC was written to fulfill a need for an early project design tool which could be used to rapidly predict the basic aerodynamics of a new configuration given basic geometry only. A vortex lattice based code was employed, as the method is robust and representation of through flow effects such as intakes or boundary layers was not required. The code has been validated against isolated propeller performance data, 2D supercritical wing pressure distributions and propeller/wing interaction tests. VORVISC has been used in project applications such as inboard wing design, wind tunnel correction estimation and flowfield prediction for a flapped wing.
 Author (CISTI)

N92-24858# University of Western Ontario, London.

LAMINAR-TURBULENT TRANSITION PROCESS IN THE PRESENCE OF SIMULATED WALL ROUGHNESS

J. M. FLORYAN, K. YAMAMOTO, and T. MURASE (Fujitsu Ltd., Tokyo, Japan) /In CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 143-155 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Understanding how surface roughness affects the laminar turbulent transition process is of particular interest in Laminar Flow Control (LFC) wing design, where stability characteristics of boundary layers with and without surface roughness are being sought. The importance of roughness shows in favourable pressure gradient laminar airfoils, where roughness is the primary agent which renders them nonlaminar in practice. Investigation of the laminar turbulent transition process in plane Poiseuille flow in the presence of distributed surface roughness has been carried out. Wall roughness has been simulated by application of a fixed wall suction/blowing in order to enable direct numerical simulation of the transition process using Fourier spectral methods. Analysis has been focused on the wall suction in the form of a single sinusoidal wave. This suction, which represents external forces applied to the flow, produced disturbances at the wall in the form of two dimensional ridges. It has been demonstrated that the presence of such disturbances can induce the laminar turbulent transition process even in cases that are completely stable when the wall is smooth. The character of the flow evolution strongly depends on the relative location of the suction parameters and the spectrum of the natural response of the flow in the parameter space. Unsteadiness of the basic state was observed to occur at much lower suction amplitudes when the suction wavenumber corresponded to the unstable range in the natural spectrum. The transition process induced by the suction was in all cases dominated by linear instability of the new (suction) modified flow.

Author (CISTI)

N92-24859# Bombardier, Inc., Montreal (Quebec).
ON THE COUPLING OF EULER/BOUNDARY-LAYER EQUATIONS

FARZAD MOKHTARIAN /in CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 157-171 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

A viscous/inviscid interaction scheme is implemented for a modified version of the FLO67 Euler code of Jameson for wing-body calculations. The FLO67 solver uses an internally generated C-grid for wing configurations which can be modified externally and used for wing-body calculations. The solver uses multi-gridding and enthalpy damping to accelerate convergence. Wing viscous effects (friction drag, displacement or transpiration surface) are computed in the method by coupling a modified Bradshaw boundary layer computation with the above finite volume Euler scheme. The laminar boundary layer is predicted by Thwaites method modified for compressible flow. The modified chord technique of Nash and Tseng is used. This technique permits a two dimensional boundary layer method to be extended to the three dimensional case provided that the flow does not deviate far from the infinite sheared wing type. This quasi three dimensional approach has been selected because it requires about an order of magnitude less computing time than a full three dimensional boundary layer calculation. The viscous/inviscid results of the above method are thus correlated against experimental results of the Onera wing and the Challenger wing-body configurations. The results are in good agreement with the test data on the Onera M6 wing. The shortcomings with the correct prediction of the shock location on the inboard wing of the Challenger wing-body are thought to be due to the quality of the single block C-type wing-body grid. Further work is required to improve the grid quality, and it is planned to put the boundary layer interaction scheme on a multi-block version of the FLO67 Euler code, currently under development.

Author (CISTI)

N92-24860# National Research Council of Canada, Ottawa (Ontario). Inst. for Aerospace Research.

A SCHEME FOR TWO DIMENSIONAL EULER AND BOUNDARY LAYER INTERACTIVE SOLUTIONS

M. KHALID and M. MOKRY /in CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 172-185 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Numerical methods for solving the Euler equations for transonic flows are now almost routinely applied to problems in external

and internal aerodynamics. However, Euler equations must be supplied with viscous corrections in situations involving attached flows. The present paper presents a procedure for coupling a boundary layer calculation with a solution of the Euler equations for flow past two dimensional profiles. The interaction of the viscous and inviscid calculations is accomplished by means of an iterative process that involves an adaptation of the mesh for the displacement thickness of the boundary layer and wake shape. The iterative approach used in the work demonstrated an adequately converged solution in 1500 multigrid cycles, utilizing about 170 integral boundary layer and 90 infinite difference boundary layer updates. The turbulence model used in the finite boundary layer subroutine is based on empirical mixing length concepts and renders the code somewhat unsuitable for cases without separation. Robustness and efficiency of the code against demanding aerodynamic cases has not yet been tested.

Author (CISTI)

N92-24861# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A TWO-DIMENSIONAL EULER SOLUTION FOR AN UNBLADED JET ENGINE CONFIGURATION

MARK E. M. STEWART /in CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 186-193 1991 Previously announced as N92-11328

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

A two dimensional nonaxisymmetric Euler solution in a geometric representation of a jet engine configuration without blades is presented. The domain, including internal and external flow, is covered with a multiblock grid. To construct the grid, a domain decomposition technique is used to subdivide the domain and smooth grids are dimensioned and placed in each block. The grid contains 44 blocks which cover the external field, the inlet, bypass duct, core duct and nozzle of the nonaxisymmetric engine configuration. The geometry is symmetric about the meanline of the hub, but the grid is not since there is no symmetry condition applied to the grid between the two halves. With a symmetric grid at zero angle of attack, the measures of the solution would cancel exactly. With an asymmetric grid, the solution will not necessarily be symmetric and the lift coefficient will not necessarily be zero. Thus, grid asymmetry can be exploited to verify the resolution of the solution. The solution may be verified on the basis of five theoretical quantities: conservation of mass and energy, deviation of the lift coefficient from zero, deviation of the drag coefficient from zero, deviations from constant entropy, and deviations in the pressure distributions over the symmetric surfaces of the components. This technique is suitable for obtaining numerical solutions in complex geometries and provides a foundation for complete engine throughflow calculations.

Author (CISTI)

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WIND-TUNNEL INVESTIGATION OF AERODYNAMIC AND STABILITY CHARACTERISTICS OF A FORWARD SWEEP WING X-29 MODEL

M. ABRAMIAN, P. KANKAINEN, E. BRUNDRETT, and J. H. G. HOWARD /in CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 194-203 1991

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

The X-29 advanced technology demonstrator includes new aerodynamic technologies such as forward swept wing, close-coupled canard, three-surface pitch control configuration, and relaxed (unstable) static margin. The paper describes a preliminary wind tunnel investigation of the static longitudinal characteristics of a 1/24th scale X-29 model which is forced to a stable configuration. Tests were conducted in the recently constructed 2 ft by 3 ft flexible wall wind tunnel at a Reynolds number of 1.85 x 10 to the 5th power based on the mean aerodynamic chord. A comparative study was conducted to investigate the overall aerodynamic performance between a naturally unstable and a forced stable configuration. Each configuration corresponds to

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various combinations of control surface (strake and canard) deflections and moment reference center locations, the effects of which on the aerodynamic coefficients were analyzed. The variation of the model aerodynamic center with the above configurations was also discussed. A preliminary flow visualization study was also conducted to qualitatively verify and describe the unsteady flow phenomena associated with the interaction between the canard and the forward swept wing. The identified stable configurations will be used for further flight tests to be conducted of a 1/8th scale radio controlled model. The present investigation is the initial attempt in a series of research projects set out to study the above technologies and their integrated effects on the aerodynamic performance of the X-29 and other forward swept wing aircraft. Author (CISTI)

N92-24863# National Research Council of Canada, Ottawa (Ontario). Applied Aerodynamics Lab.

PROPELLER NOISE RESEARCH AT NRC

N. G. BALL and D. J. BARBER (Boeing Canada Ltd., Downsview, Ontario) / In CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 205-216 1991

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

An acoustic liner has recently been built for the Institute for Aerospace Research 2 m by 3 m Low Wind Speed Tunnel. In conjunction with an improved transverse mechanism and a new high speed data system, the liner allows for measurements of the near-field harmonic noise produced by model scale propellers. Recent tests made in cooperation with Boeing of Canada Ltd., de Havilland Division have shown promising results for measurements of the blade passage tone and its first two harmonics. The measurement technique and data reduction method was able to provide a detailed mapping of both the magnitude and phase of the blade passage tone and its harmonics. The initial data show the importance of maximizing the distance between the microphone and the reflecting surfaces and raises the concern about the importance of the nacelle as a disturbance to the acoustic field. It also shows the importance of the relative phase of the harmonics in assessing the acoustic impact sound field. The facility is capable of making noise measurements that are scaled correctly, with the exception of Reynolds number, up to low speed cruise conditions for modern propeller powered aircraft. This range is adequate to provide data for code validation and limited data for comparison with flight tests. Author (CISTI)

N92-24864# Ottawa Univ. (Ontario). Dept. of Mechanical Engineering.

NONLINEAR ASPECTS OF TRANSONIC AEROELASTICITY

H. S. MURTY and G. W. JOHNSTON (Toronto Univ., Ontario) / In CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 218-237 1991

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Linear flutter analysis has been traditionally used in studies of transonic flow. A study of the effects of nonlinear transonic flow on the flutter characteristics of an airfoil is reported. The object was to determine the aerodynamic conditions under which the aerodynamic forces are essentially linear functions of airfoil motion and whether the effect of nonlinear aerodynamic forces of flutter are significant enough to invalidate the linear assumptions in traditional flutter analysis. Nonlinear effects were found to be significant for cases in which the amplitude of shock wave motion, over one cycle of unsteady oscillatory motion was greater than 5 percent chord. Assuming linearity of the transonic loads, a linear flutter analysis was carried out to determine neutral stability conditions. A time response analysis of the system at these neutral stability conditions revealed that in cases of strong aerodynamic nonlinearities, the neutral stability condition determined by traditional methods was not correct. Author (CISTI)

N92-24865# National Research Council of Canada, Ottawa (Ontario). High Speed Aerodynamics Lab.

FLOWFIELD IN THE VICINITY OF THE F/A-18 VERTICAL FIN AT HIGH-ANGLE-OF-ATTACK

B. H. K. LEE, D. BROWN, F. C. TANG, and M. PLOSENSKI / In CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 238-250 1991

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

The flowfield behind the vertical fin of a rigid 6 percent scale F/A-18 model was investigated in the Institute for Aerospace Research 1.5 m Trisonic Blowdown Tunnel. The vortical flow structure was studied with the aid of a 49 pressure sensor rake mounted on the model sting. Unsteady pressures were measured from 13 fast response transducers along the horizontal and vertical centrelines of the vortex rake. Spectral, correlation and probability density analyses were carried out. Higher pressure fluctuations in the flowfield were observed on the inboard side of the vertical fin at $\alpha = 30$ deg and 35 deg. At $\alpha = 25$ deg the vortex center was located outboard of the vertical fin. Larger pressure fluctuations were observed on the outboard side of the vertical fin. Above $\alpha = 30$ deg, pressure fluctuations measured with the vortex rake mounted between the vertical fins show quite similar results for $M = 0.6$ and 0.8. Some representative results from statistical analyses of the unsteady pressures are given at $M = 0.6$ and $\alpha = 30$ deg. Spectral studies of the vortical flowfield unsteady pressures show regions where a broad peak with a reduced frequency between 0.45 and 0.5 are detected. Cross correlation analyses indicate the pattern of vorticity to be convected mainly in the free-stream direction. The scale of eddies are not constant at different locations in the flowfields. With the vortex rake mounted behind the vertical fin, the probability densities of the unsteady transducers' signals show that the pressure fluctuations in most of the flowfield can be approximated by a Gaussian distribution. Author (CISTI)

N92-24866# Carleton Univ., Ottawa (Ontario). Dept. of Mechanical and Aerospace Engineering.

PERFORMANCE DEGRADATION DUE TO HOAR FROST ON LIFTING SURFACES

R. J. KIND and M. A. LAWRYSYN / In CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 253-263 1991

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

This paper outlines an investigation into the effects of hoar frost roughness on the aerodynamic performance of airfoils and wings. The aerodynamic characteristics of actual, naturally grown, hoar frost were determined by testing several preserved samples in a wind tunnel. Boundary layer development over the samples was measured. Effective roughness height and spacing parameters were determined from the data. Computations were then carried out to assess the effects of frost on airfoil performance. These computations were done using a viscous/inviscid interaction approach. The computations indicate that frost in the leading edge region can have dramatic negative effects on airfoil and wing performance. Frost of only 0.4 mm height was predicted to cause take-off distance to increase by more than 80 percent when present in the leading edge region of a large transport aircraft's wing. On the other hand, frost beginning well downstream of the suction peak, for example at one-quarter chord, was predicted to have little effect. Author (CISTI)

N92-24869# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

AUTOMATED GRID GENERATION FOR HIGH-LIFT CONFIGURATIONS

T. E. NELSON, D. W. ZINGG, and G. W. JOHNSTON / In CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 324-337 1991

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

An automated procedure is presented for generating multi-block grids around two-dimensional high-lift airfoil configurations. The

computational domain is subdivided into simply connected topologically rectangular blocks by tracing streamlines and equipotential lines determined from a panel method. The procedure is suitable for any number of elements with or without gaps and overlaps. Also, sharp corners and blunt trailing edges are easily accommodated. Within each block, a starting grid is generated using a simple algebraic technique. The composite grid is then smoothed using an elliptic grid generation method to produce a final grid suitable for Navier-Stokes computations. Sample grids are presented for a two element case of the GW(W)-1 airfoil with 29 percent airfoil chord Fowler flap at 40 deg and a three element case of the GA(W)-1 airfoil with flap and slat. To demonstrate the usefulness of the method, numerical results for the two element case from an established Navier-Stokes code are presented and compared to wind tunnel data. Author (CISTI)

N92-24870# University of Western Ontario, London.

FLOW VISUALIZATION USING COMPUTER ANIMATION

J. M. FLORYAN *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 338-341 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Effective numerical simulations of fluid motions hinge on availability of techniques for extracting and displaying physically relevant information that is hidden in the large data sets generated by computer. Graphical postprocessing and computer animation are most effective in the case of unsteady motions. Algorithms based on light propagation in absorbing, emitting and scattering media offer a promise for effective display of three dimensional fields. This presentation focuses on techniques that can be used for flow visualization purposes using computer animation. Different techniques were illustrated using video clips taken from various branches of fluid dynamics. These videos demonstrated the versatility and power of flow animation methodology. Very realistic flow simulations can be carried out. Most of the techniques are quite simple and have analogues in actual physical experiments. Animation of two dimensional fields can effectively be carried out using presently available methodology involving a mixture of Lagrangian and Eulerian concepts. Effective displaying of three dimensional fields is cumbersome and requires development of new methods. Algorithms based on ray propagation in an absorbing, emitting and scattering medium give best results. Author (CISTI)

N92-24871# Sherbrooke Univ. (Quebec). Dept. of Mechanical Engineering.

VIBROACOUSTIC SIMULATION OF AN AIRPLANE STRUCTURE

L. CHENG and J. NICOLAS *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 343-354 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

An analytical model is presented which is intended to investigate the vibroacoustic behavior of an airplane structure. Important phenomena have been revealed through numerical investigations. The proposed approach offers a new way of addressing mechanically coupled structures. The idea of using dynamic distribution of springs offers a new possibility of handling structural complexities at substructure junctions and boundaries. This method offers an alternative to purely numerical methods such as FEM usually used to address this kind of problem. By the comparisons with FEM, the present method is more physical, convenient, and efficient in terms of computation time. It offers a general formulation encompassing various boundary cases for the plates and shells. It also contributes to the understanding of structural coupling. In addition, numerical study on the effect of the bulkhead fixing furnishes useful sound proofing guidances. Author (CISTI)

N92-24872# Ottawa Univ. (Ontario). Dept. of Mechanical Engineering.

NONUNIQUE SOLUTIONS IN UNSTEADY TRANSONIC FLOW

H. S. MURTY *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 355-364 1991

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

The purpose of the present work was to study the occurrence of nonunique solutions in unsteady transonic flows. In this study, a full potential unsteady code was developed and applied to the analysis of flows past NACA 0012 and NACA 64A006 airfoils. Whereas previous studies provided examples of nonunique solutions using the small disturbance potential flow model, the full potential flow model could not verify those solutions. It is not the neglect of shock wave generated vorticity and entropy that is responsible for the nonunique phenomena as all potential flow models share the assumption of isentropic flow. It is possible that the variation in modelling the wake boundary conditions may affect the solution obtained. Author (CISTI)

N92-24876# Alberta Univ., Edmonton. Dept. of Mechanical Engineering.

AERODYNAMIC DESIGN AND ANALYSIS OF A LIGHT AIRCRAFT PROPELLER

B. D. MURRAY *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 425-438 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Based on the now classical propeller theory, design and analysis routines appropriate for lightly loaded propellers have been developed. The analysis routine is based upon the blade element and momentum theory and is shown to agree well with experimental results. The iterative solution did demonstrate poor convergence near the tips of blunt ended blades but this difficulty was overcome by introducing a control point just off the blade tip. The design method utilizes a helicoidal vortex wake of constant displacement velocity, as the basis for determining the optimum blade shape. The solution of the trailing vortex wake is only approximate, but nevertheless the performance characteristics as designed do agree well with the analytical performance characteristics. These routines are executed very efficiently on personal computers which has facilitated the actual design and analysis of a propeller. An optimum propeller was designed for a light aircraft that was to operate efficiently at speeds of 50 to 200 mph with an 80 HP engine. Author (CISTI)

N92-24877# Alberta Univ., Edmonton. Dept. of Mechanical Engineering.

VARIABLE GEOMETRY SAILPLANES MINISIGMA

D. J. MARSDEN *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics p 439-455 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Variable geometry on sailplanes refers to the use of some mechanical methods of changing the effective wing area to provide a better compromise between the requirements for circling and cruising flight. Successful application of this concept has proved an elusive goal. Two of the most successful flap systems are the Wortmann flap used on the original Sigma and the SB-11, and the slotted flap used on the Gemini and on the modified Sigma. The slotted flap system has a number of advantages, a major one being that it allows for more effective aileron control at low speeds. The design philosophy of the new Minisigma has been to obtain superior high speed performance through the use of a high wing loading while retaining the best features of the Sigma and Gemini, namely excellent low speed performance and handling. High wing loading can be achieved without excessive weight because of the relatively small area of the aspect ratio 27 wing. The slotted flap provides the best solution for variable geometry. It provides nearly two to one increase in effective wing area while maintaining effective aileron control power at low speeds. It has higher drag than the unslotted Fowler flap but its higher operating lift coefficient more than compensates for the difference. Safety is not compromised for heavy wing loading. The slotted flap provides impressive gains in safe handling even in the case of full water ballast. Author (CISTI)

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N92-24882*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

EXPERIMENTAL EVALUATION OF A FLAT WAKE THEORY FOR PREDICTING ROTOR INFLOW-WAKE VELOCITIES

JOHN C. WILSON Apr. 1992 53 p Prepared in cooperation with Army Aviation Systems Command, Hampton, VA (Contract DA PROJ. 1L1-62211-A-47-A; RTOP 505-59-36-01) (NASA-TM-4334; L-16953; NAS 1.15:4334; AVSCOM-TR-92-B-004; AD-A250192) Avail: NTIS HC/MF A04 CSCL 01/1

The theory for predicting helicopter inflow-wake velocities called flat wake theory was correlated with several sets of experimental data. The theory was developed by V. E. Baskin of the USSR, and a computer code known as DOWN was developed at Princeton University to implement the theory. The theory treats the wake geometry as rigid without interaction between induced velocities and wake structure. The wake structure is assumed to be a flat sheet of vorticity composed of trailing elements whose strength depends on the azimuthal and radial distributions of circulation on a rotor blade. The code predicts the three orthogonal components of flow velocity in the field surrounding the rotor. The predictions can be utilized in rotor performance and helicopter real-time flight-path simulation. The predictive capability of the coded version of flat wake theory provides vertical inflow patterns similar to experimental patterns. Author

N92-24885*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

EFFECT OF BLADE PLANFORM VARIATION ON THE FORWARD-FLIGHT PERFORMANCE OF SMALL-SCALE ROTORS

KEVIN W. NOONAN, SUSAN L. ALTHOFF, DHANANJAY K. SAMAK, and MICHAEL D. GREEN (Maryland Univ., College Park.) Apr. 1992 83 p (Contract DA PROJ. 1L1-62211-A-47-A; RTOP 505-59-87-54) (NASA-TM-4345; L-16994; NAS 1.15:4345; AVSCOM-TR-92-B-005) Avail: NTIS HC/MF A05 CSCL 01/1

An investigation was conducted in the Glenn L. Martin Wind Tunnel to determine the effect of blade planform variation on the forward-flight performance of four small-scale rotors. The rotors were 5.417 ft in diameter and differed only in blade planform geometry. The four planforms were: (1) rectangular; (2) 3:1 linear taper starting at 94 percent radius; (3) 3:1 linear taper starting at 75 percent radius; and (4) 3:1 linear taper starting at 50 percent radius. Each planform had a thrust-weighted solidity of 0.098. The investigation included forward-flight simulation at advance ratios from 0.14 to 0.43 for a range of rotor lift and drag coefficients. Among the four rotors, the rectangular rotor required the highest torque for the entire range of rotor drag coefficients attained at advanced ratios greater than 0.14 for rotor lift coefficients $C_{sub L}$ from 0.004 to 0.007. Among the rotors with tapered blades and for $C_{sub L} = 0.004$ to 0.007, either the 75 percent tapered rotor or the 50 percent tapered rotor required the least amount of torque for the full range of rotor drag coefficients attained at each advance ratio. The performance of the 94 percent tapered rotor was generally between that of the rectangular rotor and the 75 and 50 percent tapered rotors at each advance ratio for this range of rotor lift coefficients. Author

N92-24898*# MCAT Inst., San Jose, CA.
TURBULENCE MODELING FOR HYPERSONIC FLIGHT Progress Report

JORGE E. BARDINA May 1992 76 p (Contract NCC2-585) (NASA-CR-190313; NAS 1.26:190313; MCAT-92-010) Avail: NTIS HC/MF A05 CSCL 01/1

The objective of the present work is to develop, verify, and incorporate two equation turbulence models which account for the effect of compressibility at high speeds into a three dimensional Reynolds averaged Navier-Stokes code and to provide documented model descriptions and numerical procedures so that they can be implemented into the National Aerospace Plane (NASP) codes. A summary of accomplishments is listed: (1) Four codes have been

tested and evaluated against a flat plate boundary layer flow and an external supersonic flow; (2) a code named RANS was chosen because of its speed, accuracy, and versatility; (3) the code was extended from thin boundary layer to full Navier-Stokes; (4) the K-omega two equation turbulence model has been implemented into the base code; (5) a 24 degree laminar compression corner flow has been simulated and compared to other numerical simulations; and (6) work is in progress in writing the numerical method of the base code including the turbulence model. H.A.

N92-24956*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

OBSERVATIONS ON COMPUTATIONAL METHODOLOGIES FOR USE IN LARGE-SCALE, GRADIENT-BASED, MULTIDISCIPLINARY DESIGN INCORPORATING ADVANCED CFD CODES

P. A. NEWMAN, G. J.-W. HOU, H. E. JONES, A. C. TAYLOR, III, and V. M. KORIVI (Old Dominion Univ., Norfolk, VA.) Feb. 1992 19 p (Contract RTOP 505-59-53-01) (NASA-TM-104206; NAS 1.15:104206; AVSCOM-TR-92-B-007) Avail: NTIS HC/MF A03 CSCL 01/1

How a combination of various computational methodologies could reduce the enormous computational costs envisioned in using advanced CFD codes in gradient based optimized multidisciplinary design (MDD) procedures is briefly outlined. Implications of these MDD requirements upon advanced CFD codes are somewhat different than those imposed by a single discipline design. A means for satisfying these MDD requirements for gradient information is presented which appear to permit: (1) some leeway in the CFD solution algorithms which can be used; (2) an extension to 3-D problems; and (3) straightforward use of other computational methodologies. Many of these observations have previously been discussed as possibilities for doing parts of the problem more efficiently; the contribution here is observing how they fit together in a mutually beneficial way. Author

N92-24958*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SUPERSONIC JET MIXING ENHANCEMENT BY DELTA-TABS

K. B. M. Q. ZAMAN, M. F. REEDER, and M. SAMIMI (Ohio State Univ., Columbus.) 1992 17 p Proposed for presentation at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, SAE, ASME, and ASCE (Contract RTOP 505-52-62) (NASA-TM-105664; E-6993; NAS 1.15:105664; AIAA PAPER 92-3548) Avail: NTIS HC/MF A03 CSCL 01/1

The results of a continuing investigation of the effect of vortex generators, in the form of small tabs at the nozzle exit, on the evolution of a jet are reported. Primarily, tabs of triangular shape are considered, and the effect is studied up to an equivalent jet Mach number of 1.8. By changing the orientation of the tab with respect to the nozzle exit plane, streamwise vortex pairs of opposite sign were generated. This resulted in either an outward ejection of jet core fluid into the ambient or an inward indentation of the mixing layer into the core of the jet. A triangular shaped tab with its apex leaning downstream, referred to as a delta tab, was found to be the most effective in influencing the jet evolution. Two delta tabs, spaced 180 degrees apart, completely bifurcated the jet. Four delta tabs increased jet mixing substantially, more than by various other methods tried previously; the mass flux at fourteen jet diameters downstream from the nozzle increased by about 50 percent over that for the no tab case. The tabs were found to be effective in jets with laminar or turbulent boundary layers as well as in jets with low or high core turbulence intensities. Author

N92-24977*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

LONGITUDINAL AND LATERAL-DIRECTIONAL AERODYNAMIC CHARACTERISTICS OF A WING-CONE CONFIGURATION AT MACH NUMBERS FROM 2.5 TO 4.5

PETER F. COVELL, IRA J. WALKER (Lockheed Engineering and Sciences Co., Hampton, VA.), and DOROTHY T. HOWELL May

1992 176 p Contains MF as supplement
(Contract RTOP 505-61-31-08)
(NASA-TM-4337; L-16839; NAS 1.15:4337) Avail: NTIS HC/MF
A09 CSCL 01/1

A study was conducted to determine the longitudinal and lateral-directional aerodynamic characteristics of a generic wing-cone configuration at supersonic speeds. The fuselage has a 5 deg half-angle cone forebody, cylindrical midbody, and a 9 deg truncated cone afterbody. The delta wing (aspect ratio 1.0) had a 4 pct. thick diamond airfoil section. The tests were made in the Langley Unitary Plan Wind Tunnel at Mach numbers from 2.50 and 4.50. Angle of attack was varied from -4 to 28 degs, and angle of sideslip varied from -8 to 8 degs. Several configurations were studied to determine the effects of variations in wing longitudinal position, wing incidence, vertical tail configuration, canard shape, and nose bluntness. Typical effects of Reynolds number and Mach number on the longitudinal characteristics were observed. The incremental effects of the configuration variables were generally unaffected by Mach number. The directional stability characteristics of the large and small centerline mounted vertical tail configurations were significantly degraded with increasing angle of attack and Mach number.

Author

N92-25133*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPARISON OF JET PLUME SHAPE PREDICTIONS AND PLUME INFLUENCE ON SONIC BOOM SIGNATURE
RAYMOND L. BARGER and N. DUANE MELSON Mar. 1992 23 p
(Contract RTOP 505-59-53-01)
(NASA-TP-3172; L-16970; NAS 1.60:3172) Avail: NTIS HC/MF
A03 CSCL 01/1

An Euler shock-fitting marching code yields good agreement with semiempirically determined plume shapes, although the agreement decreases somewhat with increasing nozzle angle and the attendant increase in the nonisentropic nature of the flow. Some calculations for the low boom configuration with a simple engine indicated that, for flight at altitudes above 60,000 feet, the plume effect is dominant. This negates the advantages of a low boom design. At lower altitudes, plume effects are significant, but of the order that can be incorporated into the low boom design process.

Author

N92-25175*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
AN ANALYTICAL APPROACH TO GRID SENSITIVITY ANALYSIS FOR NACA FOUR-DIGIT WING SECTIONS
Progress Report, 1 Jan. - 31 Dec. 1991
I. SADREHAGHIGHI and S. N. TIWARI Apr. 1992 69 p
(Contract NCC1-68)
(NASA-CR-190251; NAS 1.26:190251) Avail: NTIS HC/MF A04

Sensitivity analysis in computational fluid dynamics with emphasis on grids and surface parameterization is described. An interactive algebraic grid-generation technique is employed to generate C-type grids around NACA four-digit wing sections. An analytical procedure is developed for calculating grid sensitivity with respect to design parameters of a wing section. A comparison of the sensitivity with that obtained using a finite difference approach is made. Grid sensitivity with respect to grid parameters, such as grid-stretching coefficients, are also investigated. Using the resultant grid sensitivity, aerodynamic sensitivity is obtained using the compressible two-dimensional thin-layer Navier-Stokes equations.

Author

N92-25202*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE NATURAL FLOW WING-DESIGN CONCEPT
RICHARD M. WOOD and STEVEN X. S. BAUER May 1992 44 p Previously announced in IAA as A89-49677
(Contract RTOP 505-61-71-01)
(NASA-TP-3193; L-16837; NAS 1.60:3193) Avail: NTIS HC/MF
A03

A wing-design study was conducted on a 65 degree swept leading-edge delta wing in which the wing geometry was modified to take advantage of the naturally occurring flow that forms over a slender wing in a supersonic flow field. Three-dimensional nonlinear analysis methods were used in the study which was divided into three parts: preliminary design, initial design, and final design. In the preliminary design, the wing planform, the design conditions, and the near-conical wing-design concept were derived, and a baseline standard wing (conventional airfoil distribution) and a baseline near-conical wing were chosen. During the initial analysis, a full-potential flow solver was employed to determine the aerodynamic characteristics of the baseline standard delta wing and to investigate modifications to the airfoil thickness, leading-edge radius, airfoil maximum-thickness position, and wing upper to lower surface asymmetry on the baseline near-conical wing. The final design employed an Euler solver to analyze the best wing configurations found in the initial design and to extend the study of wing asymmetry to develop a more refined wing. Benefits resulting from each modification are discussed, and a final 'natural flow' wing geometry was designed that provides an improvement in aerodynamic performance compared with that of a baseline conventional uncambered wing, linear-theory cambered wing, and near-conical wing.

Author

N92-25261*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ASSESSMENT OF POTENTIAL AERODYNAMIC BENEFITS FROM SPANWISE BLOWING AT THE WING TIP Ph.D. Thesis - George Washington Univ.
RAYMOND EDWARD MINECK May 1992 359 p
(NASA-TM-107847; NAS 1.15:107847) Avail: NTIS HC/MF A16

A comprehensive set of experimental and analytical investigations have been conducted to assess the potential aerodynamic benefits from spanwise blowing at the tip of a moderate aspect ratio, swept wing. An analytical model has been developed to simulate a jet exhausting from the wing tip. An experimental study of a subsonic jet exhausting from the wing tip was conducted to investigate the effect of spanwise blowing from the tip on the aerodynamic characteristics of a moderate aspect ratio, swept wing. Wing force and moment data and surface pressure data were measured at Mach numbers up to 0.72. Results indicate that small amounts of blowing from small jets increase the lift curve slope a small amount, but have no effect on drag. Larger amounts of blowing from longer jets blowing increases lift near the tip and reduce drag at low Mach numbers. These benefits decrease with increasing Mach number, and vanish at Mach 0.5. A Navier-Stokes solver with modified boundary conditions at the tip was used to extrapolate the results to a Mach number of 0.72. With current technology and conventional wing shapes, spanwise blowing at the wing tip does not appear to be a practical means of reducing drag of moderate aspect ratio wings at high subsonic Mach numbers.

Author

N92-25276*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
WIND-TUNNEL STATIC AND FREE-FLIGHT INVESTIGATION OF HIGH-ANGLE-OF-ATTACK STABILITY AND CONTROL CHARACTERISTICS OF A MODEL OF THE EA-6B AIRPLANE
FRANK L. JORDAN, JR. and DAVID E. HAHNE May 1992 60 p
(Contract RTOP 505-61-71-07)
(NASA-TP-3194; L-16813; NAS 1.60:3194) Avail: NTIS HC/MF
A04

An investigation was conducted in the Langley 30- by 60-Foot Tunnel and the Langley 12-Foot Low-Speed Tunnel to identify factors contributing to a directional divergence at high angles of attack for the EA-6B airplane. The study consisted of static wind-tunnel tests, smoke and tuft flow-visualization tests, and free-flight tests of a 1/8.5-scale model of the airplane. The results of the investigation indicate that the directional divergence of the airplane is brought about by a loss of directional stability and effective dihedral at high angles of attack. Several modifications were tested that significantly alleviate the stability problem. The

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results of the free-flight study show that the modified configuration exhibits good dynamic stability characteristics and could be flown at angles of attack significantly higher than those of the unmodified configuration. Author

N92-25279*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

AN ENGINEERING METHOD FOR INTERACTIVE INVISCID-BOUNDARY LAYERS IN THREE-DIMENSIONAL HYPERSONIC FLOWS Ph.D. Thesis - North Carolina State Univ., Raleigh

CHRISTOPHER J. RILEY 1992 138 p
(NASA-TM-107838; NAS 1.15:107838) Avail: NTIS HC/MF A07

An engineering method has been developed that couples an approximate three dimensional inviscid technique with the axisymmetric analog and a set of approximate convective heating equations. The displacement effect on the boundary layer on the outer inviscid flow is calculated and included as a boundary condition in the inviscid technique. This accounts for the viscous interaction present at lower Reynolds numbers. The method is applied to blunted axisymmetric and three dimensional elliptic cones at angle of attack for the laminar hypersonic flow of a perfect gas. The method is applied to turbulent and equilibrium-air conditions. The present technique predicts surface heating rates, pressures, and shock shapes that compare favorably with experimental (ground-test and flight) data and numerical solutions of the Navier-Stokes and viscous shock-layer equations. In addition, the inclusion of viscous interaction significantly improves results obtained at lower Reynolds numbers. The new technique represents a major improvement over current engineering aerothermal methods with only a modest increase in computational effort. Author

N92-25366# National Aerospace Lab., Tokyo (Japan). Advanced Aircraft Research Group.

STATIC AEROELASTIC ANALYSIS OF ACT WIND TUNNEL MODEL AIRCRAFT [ZENKI ACT FUSHI MOKEI NO SEITEKI KURIKI DANSEI KAISEKI]

HIROSHI MATSUSHITA, KENJI FUJII, TETSUHIKO UEDA, and MITSUNORI YANAGISAWA Jul. 1990 17 p In JAPANESE Original contains color illustrations
(NAL-TM-624; ISSN-0452-2982; JTN-92-80312) Avail: NTIS HC/MF A03

As a part of research activities on ACT (Active Control Technology) at NAL, wind tunnel tests on the ACT wind tunnel model aircraft with elastic wings were performed to investigate the effect of rigid body movement mode to gust load alleviation effects. The mathematical model of the ACT wind tunnel model aircraft was to be constructed to design the control rule of gust load alleviation. Accordingly, the related data were to be obtained by vibration tests and by wind tunnel tests. The mathematical model was to be examined using an analytical method. In the beginning, the structural analysis model using Finite Element Method (FEM) was constructed based on the measurement results of rigidity distribution, mass distribution, and inertia moment distribution. The mathematical model on structural characteristics was derived with the adjustment of the structure parameters obtained from vibration tests. The static deformation analysis method is the mathematical model obtained by the combination of the aerodynamic analysis software. The data obtained from the static aerodynamic elasticity analysis is compared with the wind tunnel test results. The inclusion of elastic effects was found to improve the correlation of analysis results with the wind tunnel test results. Details of the analysis results are reported.

Author (NASDA)

N92-25410 Aeronautical Research Labs., Melbourne (Australia). **VISUALISATION IN WATER OF VORTEX FLOW OVER SHARP-EDGED CANARD CONFIGURATIONS**

D. H. THOMPSON Apr. 1992 62 p
(ARL-FLIGHT-MECH-R-189; AR-006-587) Copyright Avail: Issuing Activity

A wing/canard configuration with sharp, highly swept leading

edges was tested in a small towing tank. Flow visualization techniques were used to study the effects of canard position on vortex interactions and vortex breakdown. A canard above or co-planar with the wing delayed wing vortex breakdown. A canard below the wing produced a strong interaction between the wing and canard vortices and could cause early wing vortex breakdown. Depending on its longitudinal position, the low canard could seriously disrupt the wing flow. Author

N92-25510*# Vigyan Research Associates, Inc., Hampton, VA. **A LOW-SPEED WIND TUNNEL STUDY OF VORTEX INTERACTION CONTROL TECHNIQUES ON A CHINE-FOREBODY/DELTA-WING CONFIGURATION**

DHANVADA M. RAO and M. K. BHAT Mar. 1992 39 p
(Contract NAS1-18856; RTOP 505-68-30-03)
(NASA-CR-189616; NAS 1.26:189616) Avail: NTIS HC/MF A03

A low speed wind tunnel evaluation was conducted of passive and active techniques proposed as a means to impede the interaction of forebody chine and delta wing vortices, when such interaction leads to undesirable aerodynamic characteristics particularly in the post stall regime. The passive method was based on physically disconnecting the chine/wing junction; the active technique employed deflection of inboard leading edge flaps. In either case, the intent was to forcibly shed the chine vortices before they encountered the downwash of wing vortices. Flow visualizations, wing pressures, and six component force/moment measurements confirmed the benefits of forced vortex de-coupling at post stall angles of attack and in sideslip, viz., alleviation of post stall zero beta asymmetry, lateral instability and twin tail buffet, with insignificant loss of maximum lift. Author

N92-25569 Florida Univ., Gainesville.

ON A MULTI-BLOCK METHOD FOR TRANSONIC TURBULENT FLOWS PAST A WING-FUSELAGE CONFIGURATION Ph.D. Thesis

CHAU-LIN LEE 1991 109 p
Avail: Univ. Microfilms Order No. DA9209040

A multi-block method being explored is further developed and investigated for the simulation of Mach 0.8 transonic turbulent flow past a wing-fuselage configuration at - 3.0 degree angle of attack. In this method, the flow field of interest is first divided into six contiguous blocks in such a way that each block is partially bounded by a solid surface. Accordingly, the solid surface is mapped onto a complete rectangular boundary plane in the computational domain for effective calculation of algebraic eddy viscosity as well as for direct application of a thin-layer Navier-Stokes code. Then, in the solution process, each block is treated as an independent flow problem, modeled by unsteady Reynolds-averaged thin-layer Navier-Stokes equations, with the interface boundary conditions updated at every time step. The employed turbulence closure model is the Baldwin-Lomax eddy viscosity model. The multi-block method being investigated has a distinct advantage in design application in that a local change to the configuration requires only the related block grid to be regenerated. However, the excessive distortion on block domain transformation, in particular the wing blocks, imposed by the special features of the method makes it difficult to generate good block grids for accurate flow simulation. Accordingly, special measures and proper techniques for quality block gridings have to be developed and investigated. Dissert. Abstr.

N92-25713*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

GRID MANAGEMENT

DANNY HWANG *In its* Workshop on Grid Generation and Related Areas p 3-15 Apr. 1992
Avail: NTIS HC/MF A08

A computational environment that allows many Computational Fluid Dynamics (CFD) engineers to work on the same project exists in the Special Project Office (SPO). This environment enables several users to carry out the task of grid generation. The grid management system, used by the engineers, is described in a

brief overview. The topics will include the grid file naming system, the grid-generation procedure, grid storage, and the grid format standard. Author

N92-25723*# Ohio State Univ., Columbus.

GRID GENERATION RESEARCH AT OSU Abstract Only

S. NAKAMURA / In NASA. Lewis Research Center, Workshop on Grid Generation and Related Areas p 121 Apr. 1992
Avail: NTIS HC/MF A08

In the last two years, effort was concentrated on: (1) surface modeling; (2) surface grid generation; and (3) 3-D flow space grid generation. The surface modeling shares the same objectives as the surface modeling in computer aided design (CAD), so software available in CAD can in principle be used for solid modeling. Unfortunately, however, the CAD software cannot be easily used in practice for grid generation purposes, because they are not designed to provide appropriate data base for grid generation. Therefore, we started developing a generalized surface modeling software from scratch, that provides the data base for the surface grid generation. Generating surface grid is an important step in generating a 3-D space for flow space. To generate a surface grid on a given surface representation, we developed a unique algorithm that works on any non-smooth surfaces. Once the surface grid is generated, a 3-D space can be generated. For this purpose, we also developed a new algorithm, which is a hybrid of the hyperbolic and the elliptic grid generation methods. With this hybrid method, orthogonality of the grid near the solid boundary can be easily achieved without introducing empirical fudge factors. Work to develop 2-D and 3-D grids for turbomachinery blade geometries was performed, and as an extension of this research we are planning to develop an adaptive grid procedure with an interactive grid environment. Author

N92-25752*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

MEASUREMENTS OF FLUCTUATING PRESSURE IN A RECTANGULAR CAVITY IN TRANSONIC FLOW AT HIGH REYNOLDS NUMBERS

M. B. TRACY, E. B. PLETOVICH, and JULIO CHU Jun. 1992 32 p
(Contract RTOP 505-68-70-08)
(NASA-TM-4363; L-16859; NAS 1.15:4363) Avail: NTIS HC/MF A03

An experiment was performed in the Langley 0.3 meter Transonic Cryogenic Tunnel to study the internal acoustic field generated by rectangular cavities in transonic and subsonic flows and to determine the effect of Reynolds number and angle of yaw on the field. The cavity was 11.25 in. long and 2.50 in. wide. The cavity depth was varied to obtain length-to-height (l/h) ratios of 4.40, 6.70, 12.67, and 20.00. Data were obtained for a free stream Mach number range from 0.20 to 0.90, a Reynolds number range from 2×10^6 to 100×10^6 per foot with a nearly constant boundary layer thickness, and for two angles of yaw of 0 and 15 degs. Results show that Reynolds number has little effect on the acoustic field in rectangular cavities at angle of yaw of 0 deg. Cavities with $l/h = 4.40$ and 6.70 generated tones at transonic speeds, whereas those with $l/h = 20.00$ did not. This trend agrees with data obtained previously at supersonic speeds. As Mach number decreased, the amplitude, and bandwidth of the tones changed. No tones appeared for Mach number = 0.20. For a cavity with $l/h = 12.67$, tones appeared at Mach number = 0.60, indicating a possible change in flow field type. Changes in acoustic spectra with angle of yaw varied with Reynolds number, Mach number, l/h ratios, and acoustic mode number. Author

N92-25814*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A NEW LAGRANGIAN METHOD FOR REAL GASES AT SUPERSONIC SPEED

C. Y. LOH and MENG-SING LIOU / In its Computational Fluid Dynamics p 75-81 Feb. 1992
Avail: NTIS HC/MF A10; 11 functional color pages

With the renewed interest in high speed flights, the real gas effect is of theoretical as well as practical importance. In the past decade, upwind splittings or Godunov-type Riemann solutions have received tremendous attention and as a result significant progress has been made both in the ideal and non-ideal gas. In this paper, we propose a new approach that is formulated using the Lagrangian description, for the calculation of supersonic/hypersonic real gas inviscid flows. This new formulation avoids the grid generation step which is automatically obtained as the solution procedure marches in the 'time-like' direction. As a result, no remapping is required and the accuracy is faithfully maintained in the Lagrangian level. In this paper, we give numerical results for a variety of real gas problems consisting of essential elements in high speed flows, such as shock waves, expansion waves, slip surfaces and their interactions. Finally, calculations for flows in a generic inlet and nozzle are presented. Author

N92-25959*# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.

FINITE ELEMENT METHODS FOR INTEGRATED AERODYNAMIC HEATING ANALYSIS Report, 1 Oct. 1990 - 30 Sep. 1991

K. MORGAN and J. PERAIRE 1991 22 p
(Contract NAGW-1809)
(NASA-CR-190353; NAS 1.26:190353) Avail: NTIS HC/MF A03

This report gives a description of the work which has been undertaken during the second year of a three year research program. The objectives of the program are to produce finite element based procedures for the solution of the large scale practical problems which are of interest to the Aerothermal Loads Branch (ALB) at NASA Langley Research Establishment. The problems of interest range from Euler simulations of full three dimensional vehicle configurations to local analyses of three dimensional viscous laminar flow. Adaptive meshes produced for both steady state and transient problems are to be considered. An important feature of the work is the provision of specialized techniques which can be used at ALB for the development of an integrated fluid/thermal/structural modeling capability. H.A.

N92-25967*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

A STATIC INVESTIGATION OF THE THRUST VECTORING SYSTEM OF THE F/A-18 HIGH-ALPHA RESEARCH VEHICLE

MARY L. MASON, FRANCIS J. CAPONE, and SCOTT C. ASBURY Washington Jun. 1992 165 p
(Contract RTOP 505-68-30-07)
(NASA-TM-4359; L-17002; NAS 1.15:4359) Avail: NTIS HC/MF A08

A static (wind-off) test was conducted in the static test facility of the Langley 16-foot Transonic Tunnel to evaluate the vectoring capability and isolated nozzle performance of the proposed thrust vectoring system of the F/A-18 high alpha research vehicle (HARV). The thrust vectoring system consisted of three asymmetrically spaced vanes installed externally on a single test nozzle. Two nozzle configurations were tested: A maximum afterburner-power nozzle and a military-power nozzle. Vane size and vane actuation geometry were investigated, and an extensive matrix of vane deflection angles was tested. The nozzle pressure ratios ranged from two to six. The results indicate that the three vane system can successfully generate multiaxis (pitch and yaw) thrust vectoring. However, large resultant vector angles incurred large thrust losses. Resultant vector angles were always lower than the vane deflection angles. The maximum thrust vectoring angles achieved for the military-power nozzle were larger than the angles achieved for the maximum afterburner-power nozzle. Author

N92-26104*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A COMPARISON OF PREDICTED AND MEASURED INLET DISTORTION FLOWS IN A SUBSONIC AXIAL INLET FLOW COMPRESSOR ROTOR

ALBERT K. OWEN Mar. 1992 198 p Prepared in cooperation with Army Aviation Systems Command, Cleveland, OH

03 AIR TRANSPORTATION AND SAFETY

(Contract DA PROJ. 1L1-61102-AH-45; RTOP 505-62-OK)
(NASA-TM-105427; E-6843; AVSCOM-TR-92-C-001; NAS
1.15:105427) Avail: NTIS HC/MF A09

Detailed flow measurements were taken inside an isolated axial compressor rotor operating subsonically near peak efficiency. These Laser Anemometer measurements were made with two inlet velocity profiles. One profile consisted of an unmodified baseline flow, and the second profile was distorted by placing axisymmetric screens on the hub and shroud well upstream of the rotor. A detailed comparison in the rotor relative reference frame between a Navier-Stokes solver and the measured experimental results showed good agreement between the predicted and measured flows. A primary flow is defined in the rotor and deviations and the computed predictions is made to assess the development of a passage vortex due to the distortion of the inlet flow. Computer predictions indicate that a distorted inlet profile has a minimal effect on the development of the flow in the rotor passage and the resulting passage vortex. Author

03

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

A92-37168

LOSS OF CABIN PRESSURIZATION IN U.S. NAVAL AIRCRAFT - 1969-90

R. BASON and D. W. YACAVONE (U.S. Navy, Naval Safety Center, Norfolk, VA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, no. 5, May 1992, p. 341-345. refs
Copyright

A report is presented on all reported incidents/mishaps of a loss of cabin or cockpit pressure in U.S. naval aircraft that occurred in flight between the years 1969 and 1990. The following information was extracted from the computerized data obtained from the Naval Safety Center: the aircraft type, the ambient altitude at decompression, the type of decompression (slow vs. fast and crew-initiated vs. accidental), the cause of decompression, the physiological problems encountered, physical injuries, oxygen equipment problems, ejections, fatalities, and loss of aircraft. Out of 205 reported cases, 184 were accidental, and the most common cause for accidental loss of cabin pressure was mechanical (73 percent), with aircraft structural damage accounting for the remaining 27 percent. Three aviators lost their lives following ejection, and seven aircraft were lost. I.S.

A92-38000

STANDARD FOR AERODYNAMIC DECELERATOR AND PARACHUTE DRAWINGS

Research sponsored by AIAA. Washington, DC, American Institute of Aeronautics and Astronautics, 1991, 54 p. refs
(ISBN 0-930403-94-0; ANSI/AIAA S-017-1991) Copyright

This AIAA Standard establishes terminology for 260 terms critical to communication about the design and function of parachutes. Requirements and guidelines on exceptions are set for the graphic description of materials, stitching, seams, views, projections, and related dimensions and tolerances consistent with current procurement practice. C.D.

A92-38207

PROSPECTS FOR A COMMERCIAL STOL TRANSPORTATION SYSTEM

JUNICHI MIYASHITA (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 54-65. In Japanese.

The development and flight test of the experimental STOL

aircraft ASUKA for a commercial transportation system are presented. The direct operating costs of STOL aircraft for commercial transportation are analyzed. The results of the investigation of the transportation system including equipment requirements are outlined. Y.P.Q.

A92-38208

THE HELICOPTER COMMUTER - A PERSPECTIVE ON REGULAR PASSENGER TRANSPORTATION BY ROTARY WING

MICHEL J. MANTIN IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 66-75.

A development history and current economic viability evaluation is conducted for a scheduled-flight commercial helicopter commuter system, based on the S-61, 24-32 seat-equipped vehicle. A comparative study is made of the operating costs of tilt-rotor, helicopter, and conventional commuter aircraft. It is noted that helicopters and tilt-wing aircraft can play a complementary role in the furnishing of commuter time-saving, albeit at slight increase in flight costs. Success of helicopter commuting depends on comprehensive, industry/government/airline operator coordination in vehicle development. O.C.

A92-38374

AGEING AIRLINER CENSUS - STILL FLYING SAFELY

IAN GOOLD Flight International (ISSN 0015-3710), vol. 141, no. 4316, April 29, 1992, p. 24-26, 30-32, 34-36.

Copyright

A review of the current status of ageing-airliner regulation is presented and the ongoing program aimed not only at fatigue, but also at corrosion, repairs, research and development, and human factors is discussed. Attention is given to the cost of ageing, analysis of service bulletins issued, current design life and fleet status, and the number and types of jet and turboprop airliners in service, by year of build. Consideration is given to the major rework to be accomplished on ten leading aircraft jet airliner designs by various age, cycle or time thresholds. R.E.P.

A92-38375

FLYING ON THIN ICE

SIMON ELLIOT and GRAHAM WARWICK Flight International (ISSN 0015-3710), vol. 141, no. 4316, April 29, 1992, p. 38-40.

Copyright

A review is presented of several recent aircraft accidents showing that present airliner antiicing measures are inadequate. Attention is given to these inadequacies and what is being done to correct them. R.E.P.

A92-39301

SAFETY AT SEA AND IN THE AIR - TAKING STOCK TOGETHER; PROCEEDINGS OF THE CONFERENCE, LONDON, ENGLAND, NOV. 13-15, 1990

Conference sponsored by Royal Aeronautical Society, Royal Institution of Naval Architects, Nautical Institute, et al. London, Royal Aeronautical Society, 1990, 239 p. For individual items see A92-39302 to A92-39310.

(ISBN 0-903409-78-X) Copyright

Topics presented include a review of the aviation safety record, the aviation legislative and regulatory framework, civil aircraft design in relation to airworthiness, aircraft structural design, assurance of safety in the aging aircraft fleet, and the potential benefits and hazards of increased reliance on cockpit automation. Also presented are the promotion of error tolerance in complex systems in the context of ships and aircraft, learning from aircraft accidents and incidents, and the broad operational scene and its management in aviation. R.E.P.

A92-39302

REVIEW OF AVIATION RECORD

J. M. RAMSDEN (Royal Aeronautical Society, London, England) IN: Safety at sea and in the air - Taking stock together; Proceedings

of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 2.0-2.16.

Copyright

An overview is presented of the world airline safety record, the major reasons for fatal accidents, and the trend that this accident rate is taking. The number of fatal crashes per million takeoffs is used as the best measure of safety in the analysis of major accidents over the last five years. The one single safety weapon named to reverse what is thought to be an upward trend in the airline accident rate is that of confidential human factors incident reporting. R.E.P.

A92-39303

CIVIL AIRCRAFT DESIGN IN RELATION TO AIRWORTHINESS

J. C. WIMPENNY (City University, London, England) IN: Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 6A.1-6A.12.

Copyright

This report shows that the steady improvement in civil aviation safety records is the outcome of a close working relationship between designers in the civil aviation industry, the airworthiness certifying authorities, and the operators. An introductory outline of the certification process from the viewpoint of the aircraft designer is presented. Attention is given to the overall airworthiness process, specific issues in aircraft and component design, and some historic airworthiness milestones. R.E.P.

A92-39305

ASSURANCE OF SAFETY IN THE AGING AIRCRAFT FLEET

P. J. HARRADINE and J. D. WARNER (Boeing Commercial Airplane Group, Seattle, WA) IN: Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 10.1-10.9.

Copyright

Recent events have focused attention on the increasing structural maintenance needs of the world's aging aircraft fleets. An overview of traditional maintenance related activities, the joint industry/authority agency initiatives currently in development, and the anticipated benefits for future generations of commercial aircraft are presented. Attention is given to the service bulletin modification program, the corrosion prevention and control program, and the evaluation of repairs. R.E.P.

A92-39310

LEARNING FROM AIRCRAFT ACCIDENTS AND INCIDENTS

K. P. R. SMART (Department of Transport, Air Accidents Investigation Branch, Farnborough, England) IN: Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 20.1-20.5.

Copyright

This report discusses the arrangements in the U.K. for the reporting and investigation of civil aircraft accidents and incidents. It focuses on the current developments in major aircraft accident investigations, studying in particular the work of the human performance and survival studies groups. The objective is to make safety recommendations to enhance survival prospects based on the understanding of the factors that led to injuries or fatalities in an accident. R.E.P.

A92-39970

RUNWAY INCURSIONS AND AIRPORT SURFACE TRAFFIC AUTOMATION

MICHAEL J. HARRISON (FAA, Washington, DC) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 12 p.

(SAE PAPER 912123) Copyright

Runway incursions occur when aircraft or vehicles get onto a runway and conflict with aircraft cleared to land or take off on that same runway. All are caused by human error. The Federal Aviation Administration has identified reducing these human errors

as a safety priority. Application of new technology is part of the solution. This paper highlights recent actions by the agency in addressing runway incursions and discusses a strategy for development of airport surface traffic automation designed to aid the air traffic controller and the pilot in identifying potential runway incursions. Airport surface traffic automation represents a conflict alert system which adds both automated safety monitoring and tools for the controller to use in reducing surface movement delays. Author

A92-39971

FLIGHT OPERATIONS SAFETY MANAGEMENT

JESSE L. MARKER (United Airlines, Seattle, WA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 12 p.

(SAE PAPER 912124) Copyright

Managing operational flight safety is critical to the success of any air carrier operation. This paper describes one process for identifying, addressing and managing risk areas associated with air carrier flight operations. The five step process involves data collection, analysis, strategy design, implementation and critique. Several examples will be presented to illustrate the practicality and effectiveness of the process. Author

A92-39977

NOISE ABATEMENT PROCEDURES VS. SAFETY

RICHARD A. DEEDS (Air Line Pilots Association, Washington, DC) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 7 p.

(SAE PAPER 912137) Copyright

The impact of aircraft noise abatement in the airport terminal area on the safety of air carrier operations is considered. Problems discussed include vertical take-off profiles that require less than minimum certified climb gradients; curfews which deny the availability of the airport to pilots; runways and conditions recommended by the National Transportation Safety Board; flight paths which do not provide in-cockpit electronic guidance to the pilot; and establishment by airports of local noise standards. O.G.

A92-40016

AGING AIRCRAFT AND STRUCTURAL AIRWORTHINESS

RICHARD JOHNSON (FAA, Technical Center, Atlantic City, NJ) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 20 p.

(SAE PAPER 912212) Copyright

An FAA program for researching aging aircraft is described which focuses on the crack formation, fatigue/corrosion interaction, the efficacy of inspections, and improper design and repair. The program comprises projects designed for multisite damage and crack growth by studying in-service practices and by modeling crack growth. The factors relating to fatigue and corrosion are discussed emphasizing the effects of structural and composite repairs and transport flight loads. The program is based on: (1) the development of an intelligent system network for maintenance and inspection; (2) corrosion control recommendations; (3) crack-detection methods and an assessment of current NDI practices; and (4) NDI system development for turbine engines. The research products outlined for structural design and NDI are expected to reduce the possibilities of fuselage failure and undetected structural defects. C.C.S.

A92-40021

AIRCRAFT GROUND DEICING

CHARLES O. MASTER (FAA, Technical Center, Atlantic City, NJ) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 9 p. refs

(SAE PAPER 912222) Copyright

An overview is presented describing current advances in the materials and procedures for the antiicing and deicing of aircraft prior to flight. Fluids for preventing icing are examined comparing the traditional North American freezing-point depressants (FPDs) with their European and military counterparts. The effectiveness

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of FPDs in general is related to holdover-time parameters which can be assessed according to performance during high-humidity and water-spray endurance tests as well as in situ holdover-time testing. Aerodynamic performance tests are also important and include flat-plate and icing-tunnel tests developed by NASA, the FAA, and aircraft manufacturers. The FAA strategy is based on the Clean Aircraft Concept which addresses operational procedures, ice detection, and holdover-time predictions. It is noted that the pilot should always be considered the ultimate authority on the condition of the aircraft. C.C.S.

A92-40022

DEVELOPMENT AND EVALUATION OF AN ONBOARD AIRCRAFT CABIN WATER SPRAY SYSTEM FOR POSTCRASH FIRE PROTECTION

RICHARD G. HILL, CONSTANTINE P. SARKOS, and TIMOTHY R. MARKER (FAA, Technical Center, Atlantic City, NJ) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 11 p. refs (SAE PAPER 912224) Copyright

This paper outlines a program that could ultimately lead to design standards for an onboard aircraft cabin water spray system to suppress postcrash fires. A brief summary of the program and the status of current activities is presented. The latter includes full-scale effectiveness tests, a study of possible problems arising from the inadvertent (or intentional) discharge of the system, and computation of the potential benefits (lives saved) from the mandatory requirement of such a system. The bulk of the paper describes the results of full-scale tests under several postcrash fire scenarios to measure the increased survival rate when using a water spray system. It is shown that a water spray system may provide passengers 2 to 3 minutes of additional time to escape under certain postcrash fire scenarios. Author

A92-40023

BRITISH AIRWAYS AIRBUS A320 PILOTS' AUTOTHURST SURVEY

STEVE LAST and MARTIN ALDER (British Airways, PLC, London, England) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 15 p. (SAE PAPER 912225) Copyright

The Airbus A320 has an autothrust system which is unique among transport aircraft in 'not having feedback movement provided to the pilots' thrust levers. There has been some controversy in the airline world over the operational aspects of this system. As British Airways was one of the earliest operators of the type, a survey was conducted to determine the views of line pilots as to the advantages and disadvantages of the system compared with conventional moving levers. This paper contains the results of that survey. It was concluded that the A320 design provides advantages in respect to engagement and selection of rated power settings, and that movement provides better disengagement and information on system function. BA concludes that from a Flight Operations perspective a future system should consider providing movement between the idle and climb power positions, while retaining the A320 thrust setting and engagement 'detents' technique. Author

N92-24713# Lawrence Livermore National Lab., CA.

WORLD COMMERCIAL AIRCRAFT ACCIDENTS: 1ST EDITION, 1946-1991

C. Y. KIMURA Feb. 1992 240 p

(Contract W-7405-ENG-48)

(DE92-009801; UCRL-ID-110003) Avail: NTIS HC/MF A11

This report is a compilation of all accidents world-wide involving aircraft in commercial service which resulted in the loss of the airframe or one or more fatality, or both. This information has been gathered in order to present a complete inventory of commercial aircraft accidents. Events involving military action, sabotage, terrorist bombings, hijackings, suicides, and industrial ground accidents are included within this list. This report is organized into six chapters. The first chapter is the introduction. The second chapter contains the compilation of accidents involving

world commercial jet aircraft from 1952 to 1991. The third chapter presents a compilation of accidents involving world commercial turboprop aircraft from 1952 to 1991. The fourth chapter presents a compilation of accidents involving world commercial pistonprop aircraft with four or more engines from 1946 to 1991. Each accident compilation or database in chapters two, three and four is presented in chronological order. Each accident is presented with information the following categories: date of accident, airline or operator and its flight number (if known), type of flight, type of aircraft and model, aircraft registration number, construction number/manufacturers serial number, aircraft damage resulting from accident, accident flight phase, accident location, number of fatalities, number of occupants, references used to compile the information, and finally cause, remarks, or description (brief) of the accident. The fifth chapter presents a list of all commercial aircraft accidents for all aircraft types with 100 or more fatalities in order of decreasing number of fatalities. Chapter six presents the commercial aircraft accidents for all aircraft types by flight phase. Future editions of this report will have additional follow-on chapters which will present other studies still in preparation at the time this edition was being prepared. DOE

N92-25262 RAND Corp., Santa Monica, CA.

TILT ROTORS AND THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY AIRPORT SYSTEM Executive Summary

JEROME AROESTY, DAVID RUBENSON, and GEOFFREY GOSLING 1992 19 p Prepared for Port Authority of New York and New Jersey, Jersey City (RAND-R-3971/1-PA-SUMM; ISBN-0-8330-1193-6) Avail: NTIS HC/MF A03

Examined here are the market, infrastructure, technology, and policy requirements for sustained commercial tilt-rotor service between the Port Authority of New York and New Jersey (PANYNJ) aviation service area and other cities in the high-volume short-haul market. The study seeks to add a degree of realism to earlier studies by incorporating potential passenger reactions to an innovative vehicle that to many people evokes an association with helicopters. The primary objective is to examine the feasibility, benefits, and drawbacks of using the major Port Authority airports to support tilt-rotor service to high volume destinations currently served by turboprop aircraft operated by regional airlines. Also examined is an airport-based tilt-rotor system between PANYNJ airports and Washington and Boston. These cities are significant because they account for 40 percent of short-haul passenger traffic at PANYNJ airports, and could potentially support commercial tilt-rotor service even at moderate or low tilt-rotor market share. Author

N92-25297# Federal Aviation Administration, Washington, DC.

AVIATION SYSTEM: CAPITAL INVESTMENT PLAN

Dec. 1991 342 p

Avail: NTIS HC/MF A15

The Federal Aviation Administration's (FAA) second annual Aviation System Capital Investment Plan (CIP) is presented. The plan describes the facilities and equipment programs that the FAA will pursue in addressing key concerns of the National Aerospace system (NAS), such as safety, efficiency, traffic demands, equipment and facilities, and airspace use. The CIP creates a plan for the evolution of the existing NAS through the use of new technologies and the development of new products obtained from continuing research. Specific topics covered include a system description; requirements that expand, relocate, or consolidate existing facilities/equipment; projects that refurbish structures, replace obsolete equipment, or relocate facilities to maintain service, improve effectiveness, or reduce cost; and projects that support logistics, provide for personnel training, and manage the information and human resource aspects of NAS modernization. Author

N92-25350# Survival Systems Ltd. (Alberta).

A REPORT ON ENHANCEMENTS FOR EXISTING AND FUTURE HELICOPTERS SUPPORTING OPERATIONS OF THE CANADIAN OIL AND GAS INDUSTRY

15 Jun. 1989 189 p Prepared for Canadian Petroleum Association, Calgary, Alberta
(CTN-91-60126) Copyright Avail: NTIS HC/MF A09

A study of safety enhancements pertaining to the safe operation of helicopters in support of oil exploration is presented. These topics include structures, seats, restraint harnesses, fuel and fuel systems, overwater operational systems, wire warning devices and flight data recorders. Under each topic related accidents are analyzed, developments and research are outlined, available equipment is reviewed, and recommendations are made regarding research and regulation. The main conclusions and recommendations are as follows: the use of shoulder restraint harnesses should be mandated and existing helicopters should be retrofitted; the use of crashworthy fuel systems would significantly reduce thermal injuries and should be considered when purchasing a helicopter; overwater operations should consider use of externally mounted liferafts, immersion suits, and automatic deployment systems; improved energy absorbing fuselages, landing gear, and seats should be considered on new acquisitions; wire warning devices should be used on operations requiring low level flying; consultation with regulatory agencies on the requirements for flight data recorders should be undertaken. A bibliography and an annex of manufacturer's promotional literature on the topic are included. CISTI

N92-26028# Systems Control Technology, Inc., Arlington, VA.
**ANALYSIS OF HELICOPTER ACCIDENT RISK EXPOSURE
NEAR HELIPOINTS, AIRPORTS, AND UNIMPROVED SITES**
Final Report

R. J. ADAMS, E. D. MCCONKEY, L. D. DZAMBA, and R. D. SMITH (Federal Aviation Administration, Washington, DC.) Feb. 1992 68 p
(Contract DTFA01-87-C-00014)
(SCT-91RR-13; DOT/FAA/RD-90/9; AD-A249127) Avail: NTIS HC/MF A04

The development of relevant safety indicators to be used in the assessment of risk exposure due to heliport design and operational standards is discussed. Since helicopter accidents have been relatively rare events, historical data at heliports are somewhat limited. Therefore, the approach described herein is to develop the total helicopter risk exposure due to all causes and then estimate what proportion of that risk should be allocated to various circumstances associated with specific heliport design and helicopter operational characteristics. This approach introduces the need for analysis and quantification of risk using a parameter or parameters that both industry and government agree are within a logical framework. Data on the number of helicopter accidents per year, accidents per 100,000 hours of flight time, accidents per 100,000 mission segments, accident rates for selected mission types, occupant risk of serious injury, and neighborhood risk are presented. Finally, civil helicopter accidents are categorized by the facilities near which they occur (heliport, airport, etc.) and by the operating facility design parameters that impact operational risk. Author

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

A92-37072

ARINC AND THE AVIONICS OF COMMERCIAL AIRCRAFT. II
[ARINC Y LA AVIONICA DE LOS AVIONES COMERCIALES. II]
J. C. MEIZOSO Ingenieria Aeronautica y Astronautica (ISSN 0020-1006), no. 327, April 1992, p. 11-17. In Spanish.
Copyright

The development of specifications for avionics systems is discussed with specific attention given to the classification of three

centralized modular IMA systems. The system architecture for the IMA comprises modular components that distribute the resources for processing, memory, and interface. A schematic description of the IMA system is given with particular attention given to the feed and feed-distribution buses and the required software. The IMA bus is described in terms of its role as the connection for the avionics system of sensors, actuators, and indicators, and the certification of the systems is described. The certification methodology focuses on the possibility of multiple failures, generic errors, and the damaging effects of EMI interference. It is suggested that the IMA systems based on the ARINC specifications can be developed as modular systems with a high degree of integration and good fault-resistance. C.C.S.

A92-37073

IBERIA'S AERONAUTICAL MAPPING APPLICATION (ACAI)
[APLICACION DE CARTOGRAFIA AERONAUTICA DE IBERIA /ACAI/]

ANTONIO C. PROVENCIO, LORENZO DEL CASTILLO CABRERIZO, IGNACIO G. TABUYO, and EUGENIO O. MONTERO (Iberia Lineas Aereas de Espana, Madrid, Spain) Ingenieria Aeronautica y Astronautica (ISSN 0020-1006), no. 327, April 1992, p. 26-32. In Spanish.
Copyright

A system of computer programs for generating aeronautical maps developed in Spain called ACAI is presented and described in terms of its design and capabilities. The ACAI utilizes six graphics stations, an Intergraph-250 central unit, and a laser plotter, and the system can generate radio-facility charts, maps of airports with departures and arrivals, and instrument approach and landing maps. The ACAI contains databases of geography, the structure of relevant airspace, and aeronautical infrastructure. The general procedures for loading data, retrieving maps, and editing map documents are set forth with attention given to the inclusion of specific information types and to map-product quality. The present version of the ACAI aeronautical mapping system can be applied effectively to aeronautical information services and procedure development as well as to automated map generation. C.C.S.

A92-37075

**POSSIBLE UTILIZATION OF GPS IN PRECISION APPROACH
MANEUVERS [POSIBLE UTILIZACION DEL GPS EN LAS
MANIOBRAS DE APROXIMACION DE PRECISION]**

MIGUEL A. S. BUENO and JOSE M. H. MARTIN Ingenieria Aeronautica y Astronautica (ISSN 0020-1006), no. 327, April 1992, p. 41-51. In Spanish. refs
Copyright

The potential of using GPS systems for precision approach maneuvers is considered by examining the influence of several sources of error. A general description of the GPS navigation system is given with attention given to the potential accuracy of the data. Possible sources of error are reviewed in terms of distance from the user, the geometry between the receiver and the satellites, and the precision of the differential mode. Navigational accuracies are given for the GPS system at 2 sigma, and the results are compared to those of the ILS system. The horizontal accuracy of the GPS system is found to be equivalent to that of the ILS system, and the vertical precision for the GPS is shown to be inadequate for certain implementations. Improvements for the GPS system are proposed based on the results, and the suggestions include improvements to the accuracy, integrity, and availability of GPS navigation data. The simultaneous use of GPS with the ILS or MLS systems is proposed as a method for augmenting the capacity of airports during adverse weather conditions. C.C.S.

A92-38380

GPS - CAN IT CONTRIBUTE TO EUROPEAN ATC?

M. E. COX, R. C. RAWLINGS, P. VAN DER KRAAN (EUROCONTROL, Brussels, Belgium), and C. LEFAS (Technical University of Crete, Chania, Greece) (NAV 91 - Conference on Satellite Navigation, London, England, Nov. 6-8, 1991) Journal of Navigation (ISSN 0373-4633), vol. 45, no. 2, May 1992, p.

205-216. refs
Copyright

This paper commences by outlining the developments expected in en-route navigation capabilities in Western Europe and describes the current provision of surveillance employing monopulse SSRS. Following a brief review of GPS characteristics, it then considers the use of ADS, in conjunction with GPS, as an alternative and/or supplement to these ground-based systems. In the light of a simple cost comparison, it suggests that the space-based system could be very advantageous, particularly where new routes are to be established in areas with little or no ATS infrastructure. A final section discusses the possibility of using GPS for height-monitoring purposes as will be necessary when a reduced vertical separation minimum of 1000 ft, is employed above FL290 in Europe, and elsewhere. Author

A92-38381

ANALYSIS OF STAND-ALONE DIFFERENTIAL GPS FOR PRECISION APPROACH

RONALD BRAFF (Mitre Corp., McLean, VA) and ROBERT LOH (FAA, Washington, DC) (NAV 91 - Conference on Satellite Navigation, London, England, Nov. 6-8, 1991) Journal of Navigation (ISSN 0373-4633), vol. 45, no. 2, May 1992, p. 217-228. refs
Copyright

A summary of the analysis of a stand-alone implementation of differential GPS as a navigation sensor for precision approaches is presented along with a description of the navigation satellite test bed under development at the FAA's Technical Center. The proposed accuracy, integrity and availability operational requirements, and their air traffic implications, are discussed. The results of the analysis are then employed to provide the rationale to recommend that FAA pursue an implementation of a wide-area differential GPS to achieve a Near CAT 1 precision approach capability. R.E.P.

A92-38384

GPS/GLONASS USER SYSTEMS IN SWEDEN

JOHNNY NILSSON (Swedavia, AB, Norrkoping, Sweden) Journal of Navigation (ISSN 0373-4633), vol. 45, no. 2, May 1992, p. 258-265.
Copyright

A research and development program of a basic satellite navigation user system developed in Sweden, called the 'GP&C Total System' is presented. Details of the system are provided and show how it can serve as a basis for the tailoring of an almost endless number of applications. This system serves to illustrate how the navigation, communication and surveillance concept and the various elements for a new global Air Navigation System published by the ICAO FANS Committee can be implemented and integrated into a user-friendly operational system. R.E.P.

A92-39560

FLIGHT TEST DATA ANALYSIS OF A LOW COST GPS/IMU INTEGRATED NAVIGATION SYSTEM

MIN-I. J. CHANG (General Dynamics Corp., Convair Div., San Diego, CA) IN: Institute of Navigation, Annual Meeting, 47th, Williamsburg, VA, June 10-12, 1991, Proceedings. Washington, DC, Institute of Navigation, 1991, p. 167-173. refs

Flight tests have been conducted to demonstrate the performance of a GPS receiver and strapdown inertial sensor integrated navigation system. A 15 state suboptimal Kalman filter was designed for inflight alignment and the calibration of the inertial sensor error sources. The estimated navigation errors are applied to correct the strapdown navigation solution and the estimated inertial sensor errors were used to update the inertial sensor measurement calibration coefficients in real time. The postflight test data analysis showed that the performance of the suboptimal Kalman filter was satisfactory. Carousel IV output verified that the multisensor navigation unit was being calibrated within the factory design specifications. Flight test results show that a low cost INS with the aid of GPS measurements can provide long term high accuracy navigation solutions. Author

A92-39565

THE STATUS OF LORAN'S IMPLEMENTATION IN THE NATIONAL AIRSPACE SYSTEM (NAS)

VINCENT L. BENCIVENGA (FAA, MLS/Loran Program Office, Washington, DC) IN: Institute of Navigation, Annual Meeting, 47th, Williamsburg, VA, June 10-12, 1991, Proceedings. Washington, DC, Institute of Navigation, 1991, p. 391-394. refs

The status of the Loran program, issues regarding its implementation in the NAS, updates on aviation blink modifications, and the recent commissioning event at El Paso, Texas, are reviewed. The numerous historic milestones of Loran's acceptance into the NAS are outlined. Loran program updates include the closing of the midcontinent gap in Loran coverage and the attainment of navigability of the contiguous U.S. entirely with Loran. The automation of aviation blink, Loran area monitors, and Loran site evaluation systems are discussed. Loran supports standard instrument approach procedures, which involve such issues as power line carrier interference, course deviation indicator sensitivity, Loran operation after cockpit radio failure, and signal-to-noise measurement. C.A.B.

A92-39567

National Aeronautics and Space Administration, Washington, DC.

RECEIVER AUTONOMOUS INTEGRITY MONITORING (RAIM) - TECHNIQUES, PERFORMANCE AND POTENTIAL

JAMES L. FARRELL (Westinghouse Defense and Electronic Systems Center, Baltimore, MD) and FRANK VAN GRAAS (Ohio University, Athens) IN: Institute of Navigation, Annual Meeting, 47th, Williamsburg, VA, June 10-12, 1991, Proceedings. Washington, DC, Institute of Navigation, 1991, p. 421-428. refs
(Contract NGR-36-009-17; DTRS-57-87-C-00006)

The goal of receiver autonomous integrity monitoring (RAIM) for the Global Positioning System (GPS) is to provide a sufficient level of navigation integrity for all phases of flight based on the signals transmitted by the GPS satellites only. Integrity requirements for airborne use of GPS are reviewed. This is followed by the description of a baseline fault detection algorithm which is shown to be capable of satisfying tentative integrity requirements. The related issue of testing the fault detection algorithm is also briefly addressed. Preliminary performance results for the baseline fault detection algorithm are presented, along with the potential of RAIM techniques for achieving GPS integrity. Author

A92-39569

A SYSTEM FOR PRECISE REAL-TIME DIFFERENTIAL GPS POSITIONING IN THE DECIMETER RANGE

HERBERT LANDAU (Muenchen, Universitaet der Bundeswehr, Neubiberg, Federal Republic of Germany) and HANS-JUERGEN EULER (TerraSat, Hoehenkirchen, Federal Republic of Germany) IN: Institute of Navigation, Annual Meeting, 47th, Williamsburg, VA, June 10-12, 1991, Proceedings. Washington, DC, Institute of Navigation, 1991, p. 443-447. refs

A GPS navigation system based on six-channel low-cost C/A code receivers reaching accuracies in the decimeter range in real-time and in the centimeter range for postmission is presented. The hard- and software components and the underlying algorithms are described. Results of accuracy experiments performed using the system in different environments are presented. C.A.B.

A92-40027

IMPLEMENTING DATA LINK ACROSS THE PACIFIC

R. S. STAHR (United Airlines, Chicago, IL) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 9 p.
(SAE PAPER 912235) Copyright

This paper examines the development and testing of long-range datalink operations over the Pacific Ocean utilizing digital data communications. The satellite communications systems are designed to be carried by a 747-400 aircraft with an aircraft-condition monitoring system and an ACARS two-way communication system. Design decisions reviewed include the message content, format, and identifier, as well as considerations for the automatic pilot interface. The system was tested in the

VHF range from an aircraft and found to function properly, and the Satcom system is tested for compatibility with the Comsat and Inmarsat satellites. The system was approved for flight and compatibility with the systems, and the six participating companies are in the position to share the transferable knowledge obtained regarding the satellite, earth station, ground service, avionics, and installation segments. C.C.S.

A92-40187

EXPERIMENTS ON AERONAUTICAL SATELLITE COMMUNICATIONS USING ETS-V SATELLITE

YOSHIHIRO HASE, HIROMITSU WAKANA, SHINICHI TAIRA, and SHINGO OHMORI Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 191-203. refs
Copyright

Through many research and development activities by many countries and organizations all over the world, aeronautical satellite communications will be implemented on a commercial basis within the coming one or two years. This paper describes the world's first aeronautical satellite communication experiments conducted in L-band frequencies using a commercial aircraft. A newly developed airborne antenna having electronically steerable beams, and communication equipment were installed in a B-747F freighter flying over transoceanic flight routes. The satellite used in these experiments is the Engineering Test Satellite-five (ETS-V). During the test period, various experiments were conducted such as antenna pattern measurements, transmission performances and voice quality evaluation. As the airborne antenna is the key component for the aeronautical satellite communication system, an emphasis has been placed on antenna characteristics. Its performances are closely related to the fading characteristics in low elevation areas and to transmission error performances.

Author

A92-40188

HIGH GAIN AIRBORNE ANTENNA FOR SATELLITE COMMUNICATIONS

SHINICHI TAIRA, MASATO TANAKA, and SHINGO OHMORI Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 205-216. refs
Copyright

The performance of the world's first airborne phased array antenna is described. The antenna is compact, lightweight, has a wide frequency bandwidth, and a low axial ratio in wide scanned angles, which is realized by a sequential array technique. The antenna was tested on board a commercial jet airliner using the ETS-V satellite and was shown to meet both the electrical and the mechanical standards required for aeronautical satellite communications. S.A.V.

A92-40199

MODERN NAVIGATION, GUIDANCE, AND CONTROL PROCESSING

CHING-FANG LIN (American GNC Corp., Chatsworth, CA) Englewood Cliffs, NJ, Prentice-Hall, 1991, 690 p. refs (ISBN 0-13-596230-7) Copyright

A sourcebook for the modelling, design, analysis, simulation, and evaluation (MDASE) of advanced navigation, guidance, and control (NGC) systems is presented. Major emphasis is placed on the practical application of advanced NGC systems. Approaches to designing, building, testing, and selecting NGC systems presented along with time-saving methods applicable to such designs and information on the current status of major aerospace programs and trends in aerospace technology. Instructions on problem solving, troubleshooting, and practical applications of MDASE are given. Applications include military and commercial aircraft, spacecraft, and missile and weapons systems. C.D.

A92-40226

ERROR ESTIMATION OF INS GROUND ALIGNMENT THROUGH OBSERVABILITY ANALYSIS

YEON F. JIANG and YU P. LIN (National Chiao Tung University, Hsinchu, Republic of China) IEEE Transactions on Aerospace

and Electronic Systems (ISSN 0018-9251), vol. 28, no. 1, Jan. 1992, p. 92-97. refs

Copyright

A systematic analysis of the observability of an inertial navigation system (INS) in ground alignment with Bar-Itzhack and Berman's error model is presented. It is shown that the unobservable states are separately contained in two decoupled subspaces. The constraints on the selection of unobservable states are discussed. An estimation algorithm which is derived fully from the horizontal velocity outputs for computing the misalignment angles is provided. It reveals that the azimuth error can be entirely estimated from the estimates of leveling error and leveling error rate, without using gyro output signals explicitly. Author

A92-40232

MLS SYSTEM ERROR MODEL IDENTIFICATION AND SYNTHESIS

R. J. KELLY (Allied-Signal Aerospace Co., Bendix Communications Div., Baltimore, MD) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. 28, no. 1, Jan. 1992, p. 164-173. refs

Copyright

A technique is described which can in principle identify the error sources in navigation systems, permitting data compression for efficient storage in a signal library. The technique can perform the inverse operation of using the library to synthesize an error generator whose output is statistically equivalent to the original error data. It can be used for multivariate hypothesis testing to determine the similarity or dissimilarity of signals at different airports and to validate equipment error budget assumptions. C.D.

A92-40239

COMPUTATION OF AIRCRAFT GEOMETRIC HEIGHT UNDER RADAR SURVEILLANCE

D. E. MANOLAKIS, C. C. LEFAS, G. S. STAVRAKAKIS (Technical University of Crete, Athens, Greece), and C. M. REKKAS (Athens, National Technical University, Greece) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. 28, no. 1, Jan. 1992, p. 241-248. refs

Copyright

This paper describes a radar system for geometric height estimation of civil aircrafts. The system consists of one standard or mode S secondary surveillance radar (SSR) and one omnidirectional antenna sited away from SSR under an airplane. The geometric height is derived by trilateration. Systematic errors are compensated for by deriving the profile of the effect on height measurements of the bias in range measurements. A curve fitting technique is then used, which estimates both the geometric height and any non-zero systematic errors. Author

N92-24302*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Tracking Systems and Applications Section.

A DEMONSTRATION OF CENTIMETER-LEVEL MONITORING OF POLAR MOTION WITH THE GLOBAL POSITIONING SYSTEM

U. J. LINDQWISTER, A. P. FREEDMAN, and G. BLEWITT In its The Telecommunications and Data Acquisition Report p 1-9 15 Feb. 1992

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 17G

Daily estimates of the Earth's pole position were obtained with the Global Positioning System (GPS) by using measurements obtained during the GPS IERS (International Earth Rotation Service) and Geodynamics (GIG'91) experiment from 22 Jan. to 13 Feb. 1991. Data from a globally distributed network consisting of 21 Rogue GPS receivers were chosen for the analysis. A comparison of the GPS polar motion series with nine 24-hour very long baseline interferometry (VLBI) estimates yielded agreement in the day-to-day pole position of about 1.5 cm for both X and Y polar motion. A similar comparison of GPS and satellite laser ranging (SLR) data showed agreement to about 1.0 cm. These preliminary results indicate that polar motion can be determined by GPS independent of, and at a level comparable to, that which is obtained from either VLBI or SLR. Furthermore, GPS can provide these data

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with a daily frequency that neither alternative technique can readily achieve. Thus, GPS promises to be a powerful tool for determining high-frequency platform parameter variation, essential for the ultraprecise spacecraft-tracking requirements of the coming years.

Author

N92-24735# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).

CURRENT ACTIVITIES AND FUTURE PLANS FOR GPS APPLICATIONS

JOHN M. DOW *In its Spacecraft Flight Dynamics* p 105-111 Dec. 1991

Copyright Avail: NTIS HC/MF A25; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

In order to prepare for support of future spacecraft requiring use of the Global Positioning System (GPS), ESA is upgrading the GPS receivers installed in several stations of its ground network, and in parallel is developing the software tools needed for high precision processing of GPS data. Preparations are underway for participation in an International GPS Geodynamics Service (IGS). A preoperational test of the IGS concept will take place over a period of three months in the Summer of 1992. The aims of this participation in relation to overall support for near Earth missions are outlined. Ongoing work in reduction of the data of a recent global GPS campaign is discussed, and a status report is given in a contract for accurate surveys of the stations of the ESA network using GPS.

ESA

N92-24799# PERI, Inc., Princeton, NJ.

CONTROLLER MEMORY ENHANCEMENT: FIELD FACILITY CONCEPTS AND TECHNIQUES Technical Report, Jan. - Nov. 1991

STAN GROMELSKI, LAURIE DAVIDSON, and EARL S. STEIN Feb. 1992 78 p

(Contract DTFA03-89-C-00050)

(DOT/FAA/CT-TN92/7) Avail: NTIS HC/MF A05

The results are presented of the 2nd year's effort in a 3 yr. project to study the role of memory in air traffic control activities. The goal was to improve controller performance of tasks where memory is a critical element. The specific goals were to identify memory aids currently in use and to explore the techniques that controllers use to manage memory. In-depth interviews were conducted with 170 controllers and a mail survey of 41 facility managers to obtain data on a range of topics, including: incidence of memory lapses; techniques controllers use to maintain awareness; perceptions of the characteristics of outstanding controllers; reported techniques and memory aids in use; and views on effective training techniques. Memory aids are listed. Recommendations are included for further research on techniques for managing memory, on the environment that promote use of memory aids, on particular memory aids, on successful training approaches, and on the establishment of a central clearing house for dissemination of information about these topics.

Author

N92-24888# Federal Aviation Administration, Atlantic City, NJ. **MLS AND DME/P MULTIPATH SIMULATION MODEL USER'S MANUAL. VOLUME 1: OPERATING INSTRUCTIONS Report, Sep. 1991**

Feb. 1992 132 p

(Contract NASA ORDER T-06038)

(DOT/FAA/CT-TN91/47) Avail: NTIS HC/MF A07

The following topics are addressed: descriptions of the model, both general and detailed; discussion of the input parameters and creation of the input file; instructions for operating each program of the model; discussion of the various options available for a given simulation; and description of the output tables, plots, and files produced by each program. A sample input file and a set of the resulting output plots and tables are included.

Author

N92-25098# Federal Aviation Administration, Atlantic City, NJ. **NATIONWIDE SYSTEM DELAY STUDY OF THE MICROWAVE LANDING SYSTEM IN THE NEW YORK TERMINAL AREA, VOLUME 1 Technical Report, Jan. - Sep. 1991**

KIMBERLY A. MAY, JOSEPH M. RICHIE, ARTHUR P. POMERANTZ, and EDWARD J. WISTON, II Dec. 1991 32 p (DOT/FAA/CT-TN91/59-VOL-1) Avail: NTIS HC/MF A03

This report contains the results of a study simulating key features of the Microwave Landing Systems in the New York Terminal Area. This analysis was conducted using the National Airspace Systems Performance Analysis Capability (NASPAC) simulation model. The results will be used by the MLS Program Office (AND-30) in assessing the economic benefits of MLS in the New York Terminal Area. This report includes a discussion of the Key features modeled, the analysis approach, and the results of the analysis. This is the first of a two volume set. The second volume describes the results of simulating MLS in the Chicago Terminal Area.

Author

N92-25470# Sandia National Labs., Albuquerque, NM.

EVALUATING THE VELOCITY ACCURACY OF AN INTEGRATED GPS/INS SYSTEM: FLIGHT TEST RESULTS

T. E. OWEN and R. WARDLAW 1991 11 p Presented at the Institute of Navigation National Technical Meeting, San Diego, CA, 27-29 Jan. 1992

(Contract DE-AC04-76DP-00789)

(DE92-007519; SAND-91-2584C; CONF-920187-1) Avail: NTIS HC/MF A03

Verifying the velocity accuracy of a GPS receiver or an integrated GPS/INS system in a dynamic environment is a difficult proposition when many of the commonly used reference systems have velocity uncertainties of the same order of magnitude or greater than the GPS system. The results of flight tests aboard an aircraft in which multiple reference systems simultaneously collected data to evaluate the accuracy of an integrated GPS/INS system are reported. Emphasis is placed on obtaining high accuracy estimates of the velocity error of the integrated system in order to verify that velocity accuracy is maintained during both linear and circular trajectories. Three different reference systems operating in parallel during flight tests are used to independently determine the position and velocity of an aircraft in flight. They are a transponder/interrogator ranging system, a laser tracker, and GPS carrier phase processing. Results obtained from these reference systems are compared against each other and against an integrated real time differential based GPS/INS system to arrive at a set of conclusions about the accuracy of the integrated system.

DOE

N92-25518# Federal Aviation Administration, Washington, DC.

GENERAL MAINTENANCE HANDBOOK FOR AIRWAY FACILITIES

15 Aug. 1991 114 p

(PB92-147586) Avail: NTIS HC/MF A06

The document discusses the Airway Facilities Maintenance Program. General administrative and management standards, procedures, and guidelines are provided for the operational maintenance of the National Airspace System (NAS) facilities and equipment.

GRA

N92-25590# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.

FLIGHT TEST OF AVIONIC AND AIR-TRAFFIC CONTROL SYSTEMS

Jul. 1991 262 p In GERMAN; ENGLISH summary Presented at Scientific Seminar, Brunswick, Fed. Republic of Germany, 4-5 Jun. 1991 Report will also be announced as translation (ESA-TT-1279)

(ETN-92-91063) Avail: NTIS HC/MF A12; DLR,

Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000

Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

DLR aircraft and their basic measuring equipment are described. The possibilities of telemetric ground equipment for the preparation and evaluation of flight tests are described. The experimental cockpit Advanced Technologies Testing Aircraft System (ATTAS) and the Air Traffic Management and Operations Simulator (ATMOS) are presented. An experimental flight management system and the concept of a movement area guidance were tested. Concept,

realization, and applications of a helicopter experimental platform are presented. A fault tolerant fly-by-light yaw control system was presented. The avionics flight evaluation system (AFES) is described. A board-autonomous flight trajectory measuring technique is presented. An experimental photoreconnaissance system is described.

ESA

N92-25595# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung. **ATTAS EXPERIMENTAL COCKPIT AND ATMOS FOR FLIGHT CONTROL COMPONENTS AND SYSTEMS INVESTIGATIONS [ATTAS EXPERIMENTAL-COCKPIT UND ATMOS FUER KOMPONENTEN- UND SYSTEMUNTERSUCHUNGEN DER FLUGFUEHRUNG]**

RALF BEYER *In its* Flight Test of Avionic and Air-Traffic Control Systems p 71-84 Jul. 1991 In GERMAN
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The experimental cockpit ATTAS (Advanced Technologies Testing Aircraft System) and the air traffic control simulator ATMOS (Air Traffic Management and Operations Simulator) are presented. ATTAS and ATMOS represent an air traffic control test environment for the study of components and systems. Both systems, together with the data link between them, enable investigation in a realistic test environment of avionics and air traffic control systems, especially the interaction between airborne and ground systems.

ESA

N92-25597# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung. **TESTING CONCEPT OF A MOVEMENT AREA GUIDANCE [ERPROBUNGSKONZEPT EINES ROLLFUEHRUNGSSYSTEMS]**
A. BECKER *In its* Flight Test of Avionic and Air-Traffic Control Systems p 105-113 Jul. 1991 In GERMAN
Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The concept of an experimental movement status and communication system for airfield surface traffic is outlined. The concept is based on the planning, control, and guidance system TARMAC (Taxi And Ramp Management and Control System). The requirements concerning movement status determination, digital communication, and position determination are discussed. The existing concepts cannot fulfill all these requirements and therefore an integrated system consisting of several subsystems is necessary.

ESA

N92-25600# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung. **GROUND AND SATELLITE SUPPORTED FLIGHT TRAJECTORY MEASUREMENT BY EXAMPLE OF THE AVIONICS FLIGHT TEST SYSTEM AFES [BODEN- UND SATELLITENGESTUETZTE FLUGBAHNVERMESSUNG AM BEISPIEL DES AVIONIK-FLUGERPROBUNGSSYSTEMS AFES]**
BERNHARD STIELER and KARLHEINZ HURRASS *In its* Flight Test of Avionic and Air-Traffic Control Systems p 177-206 Jul. 1991 In GERMAN

Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The avionics flight evaluation system (AFES) is described. Its basic sensors are a microwave radar and an inertial system. The measured signals onboard the aircraft are used in optimal estimation algorithms and provide quasi online and accurate reference trajectory calculation. The different components of the system are described. The position accuracy (horizontal and vertical) of the AFES reference system is discussed. The planned improvements (powerful airborne computer, integrated height measuring system, and global positioning system as support sensor) are outlined.

ESA

N92-25601# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.

BOARD-AUTONOMOUS FLIGHT TRAJECTORY MEASUREMENT BY EXAMPLE OF AN ILS MEASURING SYSTEM [BORDAUTONOME FLUGBAHNVERMESSUNG AM BEISPIEL EINES ILS-VERMESSUNGSSYSTEMS]

BERNHARD STIELER and KARLHEINZ HURRASS *In its* Flight Test of Avionic and Air-Traffic Control Systems p 207-232 Jul. 1991 In GERMAN

Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The possibilities and advantages of a completely board-autonomous flight trajectory measuring technique are discussed. The basic components are an inertial system, barometric and radar height measuring systems, and CCD (Charge Coupled Device) cameras. The present ILS (Instrument Landing System) system GFMS has to verify radio navigation systems for air traffic control. The concept of GFMS and the hitherto obtained results are discussed. Possibilities to improve the GFMS measuring system are given. Board-autonomous flight trajectory measuring systems supported by image processing are compared with ground and satellite supported systems.

ESA

N92-26101# Systems Control Technology, Inc., Arlington, VA. **ROTORCRAFT TERMINAL ATC ROUTE STANDARDS Final Report**

RAYMOND H. MATTHEWS and BRIAN M. SAWYER Aug. 1991 77 p

(Contract DTF A01-87-C-00014)

(SCT-90RR-33; DOT/FAA/RD-90/18; AD-A249132) Avail: NTIS HC/MF A05

Major aircraft terminal areas are examined and both visual and instrument meteorological conditions are addressed that are under visual flight rules (VFR), special visual flight rules (SVFR), and instrument flight rules (IFR). Their effect is assessed on the National Airspace System (NAS), the users, and air traffic control. The review, analysis, and development of rotorcraft ATC route structures is included along with the analysis of current procedures and standards, with the objective of recommending modifications to existing FAA documents, standards, and procedures which will enhance rotorcraft operations and NAS capacity in a terminal environment. This is one of a series of reports that address rotorcraft standards, route structures, and procedures applied by FAA air traffic facilities.

Author

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

A92-36828
EXPLORATORY DESIGN STUDIES OF ACTIVELY CONTROLLED WINGS USING INTEGRATED MULTIDISCIPLINARY SYNTHESIS

E. LIVINE, L. A. SCHMIT, and P. P. FRIEDMANN (California, University, Los Angeles) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1171-1179. Previously cited in issue 11, p. 1613, Accession no. A90-29238. refs
(Contract F49620-87-K-0003)
Copyright

A92-36855
NONLINEAR DAMPING ESTIMATION FROM ROTOR STABILITY DATA USING TIME AND FREQUENCY DOMAIN TECHNIQUES

FREDERICK TASKER and INDERJIT CHOPRA (Maryland, University, College Park) AIAA Journal (ISSN 0001-1452), vol.

30, no. 5, May 1992, p. 1383-1391. Previously cited in issue 12, p. 1781, Accession no. A89-30728. refs
Copyright

A92-37074

USE OF THE THRUST-WEIGHT DIAGRAM VERSUS TRANSPORT CARGO IN THE INITIAL DIMENSIONING OF PASSENGER-TRANSPORT AIRCRAFT [UTILIZACION DEL DIAGRAMA EMPUJE PESO FRENTE A CARGA ALAR EN EL DIMENSIONADO INICIAL DE AVIONES DE TRANSPORTE DE PASAJEROS]

J. S.-T. MARTIN and T. M. CANDEL (Escuela Tecnica Superior de Ingenieros Aeronauticos, Madrid, Spain) Ingenieria Aeronautica y Astronautica (ISSN 0020-1006), no. 327, April 1992, p. 33-40. In Spanish. refs

Copyright

Attention is given to the use of the diagram relating transport cargo with the thrust-weight ratio in the conceptual design of aircraft. Specific treatment is given to the use of this design constraint for several classes of aircraft. The analytical technique is based on the work by Roskam (1985) and Torenbeek (1976) and employs linear expressions to describe the parameters of the aircraft dimensions. Equations relating the thrust-weight ratio and cargo are appropriated from the literature and from mechanical expressions for maximum range and velocity and takeoff and landing distance. The expressions delimit the regions that contain possible design points for the aircraft, the possible load fractions, and potential fuel fractions. The present analytical technique can be used to determine the design variables required to give the initial specifications of an aircraft. C.C.S.

A92-37391

STEADY STATE AND QUASI-TRANSIENT ANALYSIS OF AIRCRAFT HYDRAULIC SYSTEM WITH NETWORK THEORY

SONG LIN, XINMIN DONG, and GUOQING HU (Northwestern Polytechnical University, Xian, People's Republic of China) Northwestern Polytechnical University, Journal (ISSN 1000-2758), vol. 10, no. 2, April 1992, p. 197-203. In Chinese. refs

Network theory is applied to the problem of steady-state analysis of aircraft hydraulic systems in order to eliminate shortcomings in simulation and difficulties in calculation. In an aircraft hydraulic system, the number of loops is much lower than that of branches, and the fluid resistance of a loop is greater than that of a branch. Thus it is advantageous to use the loop method in simulations of aircraft hydraulic systems; however, the flow step which exists in the hydraulic branch is a formidable problem. This problem is solved by means of a new equivalent circuit model of a hydraulic branch, and the nodes' flow inputs are successfully transformed into the flow inputs of the equivalent branches. The mathematical technique of generalized inversion of a matrix is used to make continuous calculation in the quasi-transient simulation possible. P.D.

A92-37576

RECENT ADVANCES IN MANEUVER LOADS ANALYSIS

KARI APPA (Northrop Corp., Aircraft Div., Hawthorne, CA) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 90, no. 1-3, Sept. 1991, p. 693-717. refs

Copyright

The conceptual design of an aircraft system requires a number of analysis cycles involving the study of various configurations for which aerodynamic and structural properties are not well defined. The aeroelastic stability and structural strength considerations are very important factors in the determination of the aerodynamic and the structural configurations. Therefore, this paper briefly reviews the specifications leading to the design loads criteria and the current analysis methods. Suggestions for research activities required in the development of a computational fluid dynamics (CFD) code and its application to predict the design loads are also included. Author

A92-37577

AEROSERVOELASTICITY

HELMUT ZIMMERMANN (Deutsche Airbus GmbH, Bremen, Federal Republic of Germany) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 90, no. 1-3, Sept. 1991, p. 719-735. refs

Copyright

For a state-space description of the flutter equation, the unsteady airloads must be represented in a form different from that of the classical flutter equation. Here, the Pade approximation and the modal synthesis method are used for this purpose, and the advantages and disadvantages of the two approaches are discussed. The results are compared with those of the supplemented classical flutter equation. The effect of nonlinearities and time delays caused by digital processing on the flutter results is examined for a fly-by-wire aircraft with an additional active system. V.L.

A92-37825

MEASURES OF MERIT FOR AIRCRAFT DYNAMIC MANEUVERING

JURI KALVISTE (Northrop Corp., Aircraft Div., Hawthorne, CA) Cockpit (ISSN 0742-1508), Jan.-Mar. 1992, p. 4-16. refs

Copyright

Agility parameters are developed to assess the dynamic maneuvering characteristics of fighter aircraft. The parameters, functions of both the time to perform the task and the spatial aspects of the maneuver, are used for a point-and-shoot engagement and roll reversal maneuver. The parameters can be also used to predict the outcome of air-to-air engagements and the time advantage that one aircraft has over another aircraft. O.G.

A92-38206

THE QUIET STOL RESEARCH AIRCRAFT ASUKA

YOSHIO HAYASHI (National Aerospace Laboratory, Chofu, Japan) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 46-53. In Japanese.

The characteristics of the ASUKA research aircraft and its design are presented. The wind tunnel tests, flight simulations, and engine tests are described. The USB (upper surface blowing) powered high lift system, the stability and control system, and structures using heat-resistant composite material are discussed. Y.P.Q.

A92-38316

AIRCRAFT HYDRAULIC SYSTEMS (3RD REVISED AND ENLARGED EDITION)

WILLIAM A. NEESE (Embry-Riddle Aeronautical University, Daytona Beach, FL) Malabar, FL, Krieger Publishing Co., 1991, 524 p. (ISBN 0-89464-562-5) Copyright

The present volume discusses current practice in aircraft fluid lines and fittings, flexible fluid lines, hydraulics seals and fluids, hydraulic system components, hydraulic pumps, and flow and pressure control valves. Also discussed are pneumatic systems, landing gear structural components and retraction systems, brake system components, aircraft wheels and tires, and hydraulic flight control systems. Attention is given to the illustrative case of the Canadair Challenger 601 business jet's hydraulic power, landing gear, and flight control systems. O.C.

A92-39082

PROPELLER AIRCRAFT INTERIOR NOISE - PHYSICAL BACKGROUND AND POSSIBLE TREATMENTS

PETER GORANSSON (Aeronautical Research Institute of Sweden, Bromma) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation,

1990, p. 805-810.

Copyright

Analytical treatment is given to the propeller as a noise source within the structural-acoustic system of aircraft with reference to proposed noise-reduction strategies. The propeller noise is characterized by a significant low-frequency component, and reductions in aircraft-interior noise can be achieved by selecting a blade-pass frequency that is far from the fifth and seventh modes of the system. Synchrophasing - the selective excitation of propeller modes - permit the use of the relative phase between the two modes to reduce interior noise without introducing a weight penalty. C.C.S.

A92-39083

SUMMARY OF DORNIER 328 INTERIOR NOISE CONTROL STUDY

I. U. BORCHERS, H. J. HACKSTEIN, P. BARTELS, M. GRUENEWALD, and C. WENIGWIESER (Dornier Luftfahrt GmbH, Friedrichshafen, Federal Republic of Germany) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 811-816. refs

Copyright

For a successful introduction of new propeller-driven commuter aircraft, the topic passenger comfort has been identified as a very important factor. A major parameter affecting this comfort is certainly the aircraft interior noise. Most airlines, therefore, require for this type of aircraft rather low cabin noise levels, which should compare with those of existing jet standards. For the development of the Dornier 328 this subject is considered in detail. The interior noise has been specified not to exceed 78 dB(A) at a minimum of 75 percent of the passenger seats, which is a relatively low level fully satisfactory and comparable with jet aircraft. The noise control program set up and currently in progress to meet this requirement is outlined in this paper and selected results are presented. Author

A92-39084

A SURVEY OF ACTIVE CONTROL IN AIRCRAFT CABINS

G. P. EATWELL (NCT /UK/, Ltd., St. John's Innovation Centre, Cambridge, England) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 817-820.

Copyright

Active noise-control techniques for the aircraft environment are reviewed including headsets, local zone cancellation, and distributed control. By examining such system parameters as weight, required power, attenuation, and controller inputs and outputs, the headset noise-cancellation system appears to be the most efficient solution. However, the use of a global system is argued to be more convenient and, when combined with zonal control for passengers, as efficient as a headset system. C.C.S.

A92-39087

PROPELLER SOUND EXCITATION ON AN AIRCRAFT FUSELAGE USING A LOUDSPEAKER RING

LARS GUSTAVSSON and BENGT SIMONSSON (Aeronautical Research Institute of Sweden, Bromma) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 829-832. refs

Copyright

A system is developed for simulating and exciting aircraft propeller fields is introduced that facilitates the characterization of interior noise in propeller aircraft. A ring of loudspeaker enclosures is mounted on a test aircraft and an acoustic mock-up of a propeller aircraft, and the system systematically varies the excitations by means of blade-passage frequency and synchrophasing. The method is shown to be of use in the evaluation of noise-control

treatment without requiring measurements from several flights.

C.C.S.

A92-39089

NOISE INSIDE AIRCRAFT FUSELAGES SUBJECTED TO AIRBORNE EXCITATION

M. GOULAIN (Aerospatiale, Toulouse, France) and C. LESUEUR (Lyon, Institut National des Sciences Appliquees, Villeurbanne, France) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 837-842. Previously announced in STAR as N91-23853. refs

Copyright

Noises inside a cockpit and a cabin and airborne and structureborne noise are summarized with the use of graphics. The necessity of having a model of acoustic and vibration transmission is outlined. The history and complexity of models, fuselage test in laboratory and a comparison of theory and experiment are discussed. The modal method is concluded to give a good understanding of the transmission phenomena through an aircraft fuselage in a 0.15 to 2.3 frequency range. The ease of use of these methods allow parametrical studies for preliminary design for noise reduction purpose. Author

A92-39304

AIRCRAFT STRUCTURAL DESIGN

F. W. VANN (British Aerospace, PLC, Hatfield, England) IN: Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 6B.1-6B.10.

Copyright

The complex and often conflicting requirements for the design of a successful civil aircraft are presented. Every additional pound of weight to any item that improves the attractiveness of the aircraft to the customer means an increase in the gross weight of the aircraft, thus necessitating increased take-off and landing distance and higher fuel consumption during cruise. The need to carry more fuel in itself increases the operating weight of the aircraft and further complicates selection of the best compromise. Therefore, the designer's primary task must be to reduce the weight of the aircraft to the absolute minimum. R.E.P.

A92-39725

B-2 HANDLING, AUTOMATION TAILORED TO TWO-PILOT CREW

WILLIAM B. SCOTT Aviation Week & Space Technology (ISSN 0005-2175), vol. 136, no. 20, May 18, 1992, p. 40-42, 44.

Copyright

An overview is presented of the B-2 bomber and its simulator trainer, described as having pilot-centered cockpits having mission-optimized flying qualities and a high degree of cockpit automation that reduces crew workload. A simulated flight mission is flown in the trainer and flight characteristics of the aircraft are described for a typical unclassified mission involving normal inflight handling. R.E.P.

A92-39913

COMMENT ON 'EFFECT OF THRUST/SPEED DEPENDENCE ON LONG-PERIOD DYNAMICS IN SUPERSONIC FLIGHT'

ROBERT F. STENGEL (Princeton University, NJ) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 795-797; Author's Reply, p. 797-799. refs

A92-39966* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

APPLICATION OF LAMINAR FLOW CONTROL TO THE HIGH SPEED CIVIL TRANSPORT - THE NASA SUPERSONIC LAMINAR FLOW CONTROL PROGRAM

MICHAEL C. FISCHER (NASA, Langley Research Center, Hampton, VA) and CHANDRA S. VEMURU (Analytical Services and Materials,

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Inc., Hampton, VA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 13 p. refs (SAE PAPER 912115) Copyright

The NASA Supersonic Laminar Flow Control (SLFC) program encompasses the development of refined CFD methods and boundary layer stability codes for the highly 3D supersonic flow conditions encountered by the F-16XL technology demonstration aircraft and the prospective High Speed Civil Transport (HSCT). While the F-16XL-1 aircraft continues to gather SLFC data, work is under way on the F-16XL-2 aircraft: which will furnish attach-line design criteria, code-calibration data, and an improved understanding of the flowfield over a wing that will add confidence to the design of HSCTs' boundary layer-controlling air-suction panels. O.C.

A92-39989

DYNAMIC RESPONSE OF LANDING GEARS ON ROUGH REPAIRED RUNWAY

TING-WHAI LEE (Menasco Aerosystems Div., Euless, TX) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 12 p. refs (SAE PAPER 912154) Copyright

The capability of the Dynamic Analysis and Design Systems (DADS) computer software to perform rough field analysis of various types of landing gears is evaluated. The use of DADS mathematical modeling of the gears and nonlinear shock strut dynamic force calculations is described. Demonstration models, numerical examples, and comparisons with FORTRAN show that DADS provides greater ease and flexibility of use in modeling and studying most types of landing gear systems in a much shorter time frame. C.D.

A92-39990

CUT PROGRESSION DURING DYNAMOMETER TESTING OF FOREIGN OBJECT DAMAGED TYPE VII EXTRA HIGH PRESSURE AIRCRAFT TIRES

PETER C. VORUM (USAF, Wright Laboratory, Wright-Patterson AFB, OH) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 18 p. refs (SAE PAPER 912155) Copyright

This report follows a group of type-VII extra-high-pressure tires which were damaged by running them over a debris-strewn test bed, then run through alternating taxi-takeoff and landing-taxi tests on a 3.05-meter dynamometer. Only 1.3-23 percent of the debris struck by these tires resulted in cuts. While testing on the dynamometer, the cut depth grew rapidly until it reached the outer carcass ply, then slowed. The test group included new and recapped bias ply, and prototype radial main landing gear tires. Author

A92-39992* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

26 X 6.6 RADIAL-BELTED AIRCRAFT TIRE PERFORMANCE

PAMELA A. DAVIS, VELORIA J. MARTINSON, THOMAS J. YAGER, and SANDY M. STUBBS (NASA, Langley Research Center, Hampton, VA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 11 p. refs (SAE PAPER 912157) Copyright

Preliminary results from testing of 26 x 6.6 radial-belted and bias-ply aircraft tires at NASA Langley's Aircraft Landing Dynamics Facility (ALDF) are reviewed. The 26 x 6.6 tire size evaluation includes cornering performance tests throughout the aircraft ground operational speed range for both dry and wet runway surfaces. Static test results to define 26 x 6.6 tire vertical stiffness properties are also presented and discussed. Author

A92-39999

QUANTIFICATION OF AIRCRAFT CARBON BRAKE WEAR USING REGRESSION ANALYSIS AND PERIODIC WAVE FORMS

JAMES F. TARTER (Aircraft Braking Systems Corp., Akron, OH) SAE, Aerospace Technology Conference and Exposition, Long

Beach, CA, Sept. 23-26, 1991. 18 p. refs (SAE PAPER 912174) Copyright

A new method has been developed to measure and quantify aircraft brake wear. This information is used to evaluate brake life, investigate the effects of design changes, and predict worn brake performance. The process is based on digital acquisition of worn brake disk data. Regression analysis is used to fit the profile data to a specially developed 3D linear model which quantifies total wear and linear taper. Fourier transforms of the profile data yield frequencies, wave lengths, and phases of the dominant periodic wave forms, which define the profile nonlinearities. Development of these methods has resulted in a new and unique technique for evaluation of aircraft brake wear. Author

A92-40000

TESTING OF A TITANIUM MATRIX COMPOSITE LANDING GEAR

MARK A. SHEA, WILLIAM W. MACY (McDonnell Douglas Corp., Saint Louis, MO), and DAVID L. MORRIS (USAF, Wright Laboratory, Wright-Patterson AFB, OH) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 11 p. (SAE PAPER 912175) Copyright

The testing of a titanium matrix composite (TMC) F-15 nose gear outer cylinder is discussed. Two cylinders were fabricated. An entire F-15 nose gear was assembled using the first cylinder. This test gear underwent static structural tests to three critical loading conditions and functional evaluations including load-stroke, rebound snubbing, jig drops and strut stroke cycling. The TMC cylinder successfully completed both groups of testing with no signs of structural or functional degradation. Author

A92-40004

CONDOR - AN ALL ELECTRIC AIRPLANE

S. MEHDI, R. N. JOHNSON, and W. J. HASTINGS (Boeing Military Airplanes, Seattle, WA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 9 p. (SAE PAPER 912184) Copyright

The Condor unmanned vehicle's control surfaces are operated by four basic electromechanical actuator types; similar actuation is used by the Condor propulsion system. An account is presently given of the design features and performance capabilities of the actuators and the electrical power generation and distribution systems employed. The electrical system encompasses two engine-mounted 270 V ac homopolar generators employing high-energy permanent magnets. Uninterruptible power is furnished to flight-critical equipment by a 28 V dc bus that is backed up by a battery with diode isolation. Pertinent flight test results are presented. O.C.

A92-40009

CONCORDE FLIGHT TESTING - POWERPLANT AND PERFORMANCE FLYING

E. B. TRUBSHAW (British Aerospace, PLC, London, England) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 15 p. (SAE PAPER 912192) Copyright

Concorde, the first major civil airliner project conducted on a collaborative basis, employed two assembly lines and two flight-test centers; the flight test program allocated the main tasks to each of the initial developmental aircraft. Attention is presently given to milestones and lessons associated with the powerplant test and performance flight test programs, encompassing the air-intake control system, engine inlet surges, aircraft response to atmospheric disturbances, deicing trials, and performance monitoring during takeoff, cruise, and landing. O.C.

A92-40010

CONCORDE, FIFTEEN YEARS ON THE FRONT LINE

DAVID MACDONALD (British Airways, PLC, London, England) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 10 p. (SAE PAPER 912193) Copyright

Development and service histories are presented for the Concorde SST at the completion of 15 years of airline operations. Attention is given to the problems that have emerged in the broad categories of structures, systems, spare parts, and the organization of maintenance efforts, as well as the ways in which they were effectively and economically addressed. Concorde introduced such technical innovations as fly-by-wire controls, electronic powerplant control, intake and exhaust flow management, afterburning engines, center-of-gravity control via fuel tankage management, and carbon fiber-reinforced structures. O.C.

A92-40028

1991 REPORT TO THE AEROSPACE PROFESSION; SETP SYMPOSIUM, 35TH, BEVERLY HILLS, CA, SEPT. 26-28, 1991, PROCEEDINGS

Lancaster, CA, Society of Experimental Test Pilots, 1991, 327 p. For individual items see A92-40029 to A92-40043.

Copyright

Topics presented include an evaluation of F-14 dual hydraulic failure flying qualities, the Pond Racer preliminary flight test report, piloted simulator studies of the HL-20 lifting body, and the X-31 flight test update. Also presented are the single engine testing of the F-14A(Plus) airplane in the power approach configuration, demonstration/validation of the YF-22A prototype advanced tactical fighter, MD-11 status report, and the Hummingbird experience at Lockheed, Georgia. R.E.P.

A92-40029

F-14 DUAL HYDRAULIC FAILURE FLYING QUALITIES EVALUATION

STEVE MINNICH (U.S. Navy, Naval Air Test Center, Patuxent River, MD) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 4-15.

Copyright

The flying qualities of the F-14 in the event of failure of both primary hydraulic systems were investigated during full scale development and were further evaluated during testing at the Naval Air Test Center during the winter of 1991. The methodology used by the test team in determining a safe in-flight refueling technique and landing configuration is addressed. Lessons learned on the subjects of tolerances and pilot technique that are applicable to all flying qualities testing are presented. R.E.P.

A92-40030

JAS 39 GRIPEN FLIGHT TEST REPORT

PER PELLEBERGS and ARNE LINDHOLM (Saab-Scania, AB, Aircraft Div., Linköping, Sweden) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 16-26.

Copyright

A review is presented of the current status of the JAS 39 Gripen flight test program and some of the project's milestones in the development of this aircraft. Attention is given to the Gripen operational concept and a comparison with the JAS 37 Viggen that it is slated to replace. Consideration is given to the flight envelope, the aerodynamics, general flying characteristics, and the engine with afterburner. R.E.P.

A92-40031

THE POND RACER PRELIMINARY FLIGHT TEST REPORT

DICK RUTAN (Mojave Airport, CA) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 27-31.

Copyright

An overview is presented of the design, development and flight test of the Pond Racer, an aircraft commissioned to be capable of setting a new propeller driven speed record and competing in the 'Reno style' unlimited air racing circuit. The design challenges including aerodynamics requiring excellent controllability at 430

knots while at low race course altitude, the adaptation of high performance automotive racing engines, and a stiff structure with low drag, are presented. Attention is given to propeller transonic shock wave control, engine thermal heat rejection at 1000 HP, and gear boxes to reduce the engine's 8000 rpm to the 2100 rpm of the propeller. Consideration is given to initial flight test results and a general description of the aircraft. R.E.P.

A92-40032

NATIONAL AEROSPACE PLANE FLIGHT TEST - EXTERNAL BURNING ON THE F/A-18

CHRIS A. HADFIELD, SHARON W. HOUCK, and FRANK G. DAWSON (U.S. Navy, Naval Air Test Center, Patuxent River, MD) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 32-43.

Copyright

A review is presented of the flight tests conducted by the X-30 flight test vehicle to investigate external burning (as a method to reduce the effect of the additional drag caused by the low pressure region of the over-expanded nozzle) in the design of the NASP. The tests showed that the carrying, expending, and burning of hydrogen may be safely conducted during flight test. The experience gained and the lessons learned in conducting the F/A-18 external hydrogen burning flight test may be directly applied to future NASP component testing, improving the efficiency and safety of the program. R.E.P.

A92-40034

X-31 FLIGHT TEST UPDATE

FRED D. KNOX (Rockwell International Corp., Palmdale, CA) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 85-103.

Copyright

The X-31 flight test program conducted during the past year is summarized with emphasis on unique features of the aircraft and the challenges faced in operating such a new aircraft. Selected flight test results of the X-31 program to demonstrate the tactical utility of enhanced fighter maneuverability and air combat potential are presented. Attention is given to a description of the aircraft, flight control laws, general handling qualities, reversionary flight modes, and thrust vectoring. R.E.P.

A92-40035

RAFALE: PROGRAM UPDATE - DEVELOPMENT OF A NAVAL VERSION

YVES KERHERVE (Dassault Aviation, Vaucresson, France) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 104-117.

Copyright

A program overview is presented of the development of a naval aircraft carrier version of the French Rafale fighter, which is to be operational and carrier-embarked in 1996. Demonstrator tests are described that include field carrier landing and carrier approach techniques. General handling qualities, flight performance, and design modifications are described. Attention is given to the Rafale's shore-based carrier suitability tests, which are to be conducted at the unique facilities of Lakehurst and Patuxent in the U.S. R.E.P.

A92-40036

SINGLE ENGINE TESTING OF THE F-14A(PLUS) AIRPLANE IN THE POWER APPROACH CONFIGURATION

B. W. JETT and R. J. HARNEY (U.S. Navy, Naval Air Test Center, Patuxent River, MD) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 118-132.

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The methods utilized to evaluate single engine handling qualities and performance of the F-14A(PLUS) aircraft in configuration power

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

approach are presented. The question of minimum control speed flight test methods for high thrust-to-weight aircraft is addressed. Specific aircraft subsystems such as the asymmetric thrust limiting system and the reduced arrestment thrust system were evaluated for functionality and effects on airplane performance and handling. R.E.P.

A92-40037

YF-22A PROTOTYPE ADVANCED TACTICAL FIGHTER DEMONSTRATION/VALIDATION FLIGHT TEST PROGRAM OVERVIEW

RICHARD ABRAMS and DAVID L. FERGUSON (Lockheed Advanced Development Co., Burbank, CA) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 133-178.

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This report describes some of the YF-22A's unique design features and the demonstration/validation flight tests completed by it in December 1990. The design goals of the aircraft were attained with the incorporation of a number of new and innovative technologies including integrated flight and propulsion control, thrust vectoring, internal weapons carriage, and composite materials. Attention is given to a general description of the aircraft and engines, flight test instrumentation, test mission control and data processing, and flight test results. R.E.P.

A92-40038

V-22 FULL SCALE DEVELOPMENT TESTING

ROBERT C. PRICE (U.S. Navy, Naval Air Test Center, Fort Worth, TX) and PETER A. LEVOCI (U.S. Navy, Naval Air Test Center, Wilmington, DE) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 181-189.

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A general description of the V-22 Osprey, a multimission tiltrotor VTOL aircraft that combines the vertical flight capabilities of a helicopter with the speed and range performance of a turboprop airplane is described. The flight control system of the V-22 comprises four primary subsystems: the cockpit controls, separate control actuators, the digital flight control computers, and the proprotor systems. Attention is given to the initial sea trials that included both aircraft landings and takeoffs, and handling and maintenance qualities aboard ship. R.E.P.

A92-40040

MD-11 STATUS REPORT

JOHN I. MILLER (McDonnell Douglas Corp., Saint Louis, MO) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 222-233.

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A review is presented of the MD-11 commercial transport certification flight test program leading to issuance of the type certificate in November 1990. Attention is given to a description of the five aircraft used in the test program, high speed envelope expansion tests, aircraft avionics, the automatic flight system, and the flight management system. Consideration is given to post certification testing including category IIb autoland, air system and fuel system problems, and improvements in range performance to meet payload/range guarantees. R.E.P.

A92-40041

THE HUMMINGBIRD EXPERIENCE AT LOCKHEED GEORGIA

B. J. DVORSCAK IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 236-254. refs

Copyright

The design configuration and flight test experience of the XV-4A/4B, a twin-engine, midwing aircraft equipped for both conventional and vertical takeoff and landing are presented.

Attention is given to the flight control system, the propulsion system, the lift system, and the stability augmentation system. Flight test preparations including wind tunnel tests, full scale lift engine inlet development tests, and cyclic testing of the reaction controls are described. R.E.P.

A92-40042

DC-3 HANDLING QUALITIES FLIGHT TESTS: NACA - 1950

JOHN A. HARPER IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 255-274. refs

Copyright

A review is presented of the DC-3 flight research program conducted in 1950 by the National Advisory Committee for Aeronautics (NACA) focusing on extracting stability derivatives from flight test data and quantifying handling qualities standards. Attention is given to a description of the test aircraft, flight test objectives, flight program implementation, and test results. Combined flight conditions are discussed showing how stability and control shortcomings can act together under extreme conditions to result in dangerous and even catastrophic situations. R.E.P.

A92-40043

EUROPEAN FIGHTER AIRCRAFT (EFA) PROGRAMME STATUS REPORT

PETER WEGER (MBB GmbH, Munich, Federal Republic of Germany) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 286-317.

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The development of EFA aerodynamics, structure and engine is presented and worksharing principles among the four participating nations are discussed. Attention is given to the delta-canard design, the flight control system, and flight control law characteristics. Consideration is given to the basic mass empty requirement of the aircraft, the use of composite materials, advanced manufacturing processes, and a description of the afterburning turbofan engines. R.E.P.

A92-40384

TILTROTOR UAV - THE NEXT GENERATION UNMANNED SYSTEM

BRADFORD M. BROWN (Unmanned Aerial Vehicle Joint Project Office, Washington, DC), CHARLES H. JACOBUS, and PATRICK G. HALL (Bell Helicopter Textron, Inc., Fort Worth, TX) Vertiflite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 18-24. refs

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DOD has recently approved a requirement for a VTOL Maritime Unmanned Aerial Vehicle (UAV) able to operate from the decks of small surface ships. This paper examines the fleet defense that will be provided by this Tiltrotor VTOL UAV and reviews plans for the team development and demonstration of the UAV. C.D.

A92-40385

SIKORSKY AIRCRAFT UAV PROGRAM

JAMES P. CYCON (Sikorsky Aircraft, Stratford, CT) Vertiflite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 26-30.

Copyright

Sikorsky Aircraft is developing a VTOL system based on a shrouded rotor VTOL UAV called Cypher which is designed to be simple to operate, to survive in high threat environments, and to require minimal logistics support. The current status of this program is reviewed and a technical description of the Cypher is presented. The command and control system mission payload, operational aspects, and missions of the Cypher system are described. C.D.

A92-40387

CONCEPTUAL DESIGN AND ANALYSIS OF A SPECIAL OPERATIONS TRANSPORT

ANTHONY RUSCELLO (USAF, Directorate of Design Analysis,

Wright-Patterson AFB, OH) Vertilite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 38-45.

Copyright

The mission requirements involved in the design of a special operations transport (SOT) for inserting and extracting personnel and cargo deep in hostile territory are listed, and the possibility of satisfying these requirements is examined. The most promising concepts for SOTs are identified by their performance, weight, size, and complexity. The full performance envelope of the selected baseline SOT is explored and compared with aircraft currently performing in the special operations arena. Critical enabling technologies which can be used to focus related research and development efforts are identified. C.D.

A92-40388

THE H-53E SUPER STALLION - A COST-EFFECTIVE SOLUTION TO MULTI-SERVICE MEDIUM/HEAVY LIFT REQUIREMENTS

MICHAEL J. CUPPERNULL and JOHN OLSON (Sikorsky Aircraft, Stratford, CT) Vertilite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 50-52.

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Planned upgradings in the H-53E Super Stallion military helicopter are discussed. Improvements that will lower operating costs, increase mission capability, enhance safety, reliability and maintainability, and increase the payload are addressed. C.D.

A92-40389

AEROELASTICITY AND THE TILTROTOR VTOL AIRCRAFT

ROBERT G. LOEWY (Rensselaer Polytechnic Institute, Troy, NY) Vertilite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 53-66.

Copyright

The aeroelasticity phenomenon in Tiltrotor VTOL aircraft is discussed here in some detail. The civilian and military applications of Tiltrotor VTOL aircraft are examined. C.D.

A92-40393

1991-92 AHS TECHNICAL COMMITTEE HIGHLIGHTS - DYNAMICS

WILLIAM H. WELLER (United Technologies Research Center, East Hartford, CT) Vertilite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 80-83.

Copyright

Advances made in 1991-92 in a variety of helicopter dynamics fields are reviewed. The areas considered include comprehensive aeroelastic analysis, airframe finite element modeling, design optimization, tilt rotor technology, rotor testing and development of new test systems. C.D.

A92-40545

EIPOS FOR ICE-FORMATION CONTROL ON AIRCRAFT IN FLIGHT - AN ALTERNATIVE TECHNIQUE

I. A. LEVIN (Soviet Innovation Centre Impulse Apparatus, Moscow, Russia) Institution of Mechanical Engineers, Proceedings, Part G - Journal of Aerospace Engineering (ISSN 0954-4100), vol. 205, no. G2, 1991, p. 81-88. refs

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This paper traces the history of ice-formation control on aircraft in flight and the efforts made to provide an alternative to the uneconomic heating techniques. The EIPOS was developed in the USSR and uses dynamic wave pulses generated directly in the structure by an external electrodynamic field to break up the ice. The method has proved so successful that it is now finding applications in other fields. Author

A92-40884

A COMPARISON OF FATIGUE LIFE PREDICTION METHODOLOGIES FOR ROTORCRAFT

RICHARD A. EVERETT, JR. (U.S. Army, Aviation Systems Command, Hampton, VA) American Helicopter Society, Journal (ISSN 0002-8711), vol. 37, no. 2, April 1992, p. 54-60. Previously

announced in STAR as N91-15604. refs
Copyright

Because of the current U.S. Army requirement that all new rotorcraft be designed to a 'six nines' reliability on fatigue life, this study was undertaken to assess the accuracy of the current safe life philosophy using the nominal stress Palmgren-Miner linear cumulative damage rule to predict the fatigue life of rotorcraft dynamic components. It has been shown that this methodology can predict fatigue lives that differ from test lives by more than two orders of magnitude. A further objective of this work was to compare the accuracy of this methodology to another safe life method called the local strain approach as well as to a method which predicts fatigue life based solely on crack growth data. Spectrum fatigue tests were run on notched ($k(\text{sub } t) = 3.2$) specimens made of 4340 steel using the Felix/28 tests fairly well, being slightly on the unconservative side of the test data. The crack growth method, which is based on 'small crack' crack growth data and a crack-closure model, also predicted the fatigue lives very well with the predicted lives being slightly longer than the mean test lives but within the experimental scatter band. The crack growth model was also able to predict the change in test lives produced by the rainflow reconstructed spectra. Author

A92-40885*

National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

SOME ISSUES ON MODELING ATMOSPHERIC TURBULENCE EXPERIENCED BY HELICOPTER ROTOR BLADES

MARK COSTELLO (Georgia Institute of Technology, Atlanta), G. H. GAONKAR (Florida Atlantic University, Boca Raton), J. V. R. PRASAD, and D. P. SCHRAGE (Georgia Institute of Technology, Atlanta) American Helicopter Society, Journal (ISSN 0002-8711), vol. 37, no. 2, April 1992, p. 71-75. refs
(Contract NCA2-512)

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The atmospheric turbulence velocities seen by nonrotating aircraft components and rotating blades can be substantially different. The differences are due to the spatial motion of the rotor blades, which move fore and aft through the gust waves. Body-fixed atmospheric turbulence refers to the actual atmospheric turbulence experienced by a point fixed on a nonrotating aircraft component such as the aircraft's center of gravity or the rotor hub, while blade-fixed atmospheric turbulence refers to the atmospheric turbulence experienced by an element of the rotating rotor blade. An example is presented, which, though overly simplified, shows important differences between blade- and body-fixed rotorcraft atmospheric turbulence models. All of the information necessary to develop the dynamic equations describing the atmospheric turbulence velocity field experienced by an aircraft is contained in the atmospheric turbulence velocity correlation matrix. It is for this reason that a generalized formulation of the correlation matrix describing atmospheric turbulence that a rotating blade encounters is developed. From this correlation matrix, earlier treated cases restricted to a rotor flying straight and level directly into the mean wind can be recovered as special cases. Author

A92-40897

MODERN AIRCRAFT DESIGN. VOL. 1 (2ND EDITION)

MARTIN HOLLMANN Monterey, CA, Aircraft Designs, Inc., 1991, 253 p. refs

Copyright

The book provides a combination of basic design technology and advanced engineering methods for designing and building the next generation of composite-material aircraft. Emphasis is placed on the three-wing aircraft, whose specific advantages are discussed. In particular, attention is given to gross weight calculation, wing sizing, engine selection, aircraft performance, selecting airfoils, vertical tail sizing, and horizontal tail trim. The properties of metallic materials and composite laminates, composite sandwich materials, and mechanical fasteners are discussed. The discussion also covers structural sizing of a composite wing, designing and analyzing joints, flight testing, and computer programs for aircraft design. V.L.

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

N92-24556# Doellner (O. Leonard), Tucson, AZ.

RADIANT ENERGY POWER SOURCE FOR JET AIRCRAFT

O. LEONARD DOELLNER Feb. 1992 38 p
(Contract DE-FG01-86CE-15301; DE-FG01-82CE-15144)
(DE92-008726; DOE/CE-15301/T15) Avail: NTIS HC/MF A03

This report begins with a historical overview on the origin and early beginnings of a radiant energy power source for jet aircraft. The report reviews the work done in Phase 1 (Grant DE-FG01-82CE-15144) and then gives a discussion of Phase 2 (Grant DE-FG01-86CE-15301). Included is a reasonably detailed discussion of photovoltaic cells and the research and development needed in this area. The report closes with a historical perspective and summary related to situations historically encountered on projects of this nature. DOE

N92-24964# Technische Univ., Delft (Netherlands).

CAD PRODUCT DATA EXCHANGE: CONVERSIONS FOR CURVES AND SURFACES Ph.D. Thesis

ANNE ELISABETH VRIES-BAAYENS 1991 186 p Sponsored by Netherlands Foundation for Technical Research (ISBN-90-6275-723-9; ETN-92-91300) Copyright Avail: NTIS HC/MF A09

Problems caused by the increasing product data exchanged between computer aided design (CAD) systems are addressed. One of these problems concerns the exchange of geometrical representations of products. This problem can be solved by methods for the conversion of these representations into each other. The reasons to exchange are described as well as the type of product data which are exchanged and the problems which can occur if these data are exchanged. A number of methods to convert the geometrical representations of curves and free formed surfaces are described. The currently used geometrical representations on CAD systems were taken into consideration, namely the B spline, Bezier, and power basis representation. The geometry conversions needed were determined for product data exchange between CAD systems. Except for the conversions between the three representations mentioned, it appeared to be necessary to be able to change the degree or parameter area of the representation and to convert an implicit description into an explicit one. Methods for these conversions were developed and are described. Software programs are available for the conversions. ESA

N92-24966# Technische Univ., Delft (Netherlands).

TOWARDS GLARE: THE DEVELOPMENT OF A FATIGUE INSENSITIVE AND DAMAGE TOLERANT AIRCRAFT MATERIAL Ph.D. Thesis

GERARDUS HUBERTUS JO ROEBROEKS 1991 273 p Sponsored by Akzo Zout Chemie (ETN-92-91301) Avail: NTIS HC/MF A12

The constant amplitude fatigue behavior of ARALL is investigated. The fatigue crack growth rates in ARALL 2 increase considerably when failure of the crack bridging fiber layers occurs. This fiber failure behavior was studied. The influences of fatigue loading conditions and specimen geometry, are shown. The fiber failure model was used to develop a material in which fiber failure does not occur. In this material (GLARE), high strength glass fibers are used instead of aramid fibers. The strength (both notched and unnotched specimen) of ARALL and a first version of GLARE are compared. A clear advantage of GLARE over ARALL is found. The composition of GLARE is optimized. ESA

N92-25263*# California State Polytechnic Univ., Pomona. Dept. of Aerospace Engineering.

SHARP: SUBSONIC HIGH ALTITUDE RESEARCH PLATFORM Final Report

TODD BEALS, CRAIG BURTON, AILEEN CABATAN, CHRISTINE HERMANO, TOM JONES, SUSAN LEE, and BRIAN RADLOFF 1991 92 p (Contract NASW-4435)

(NAS-CR-190004; NAS 1.26:190004) Avail: NTIS HC/MF A05

The Universities Space Research Association is sponsoring an undergraduate program which is geared to designing an aircraft

that can study the ozone layer at the equator. This aircraft must be able to satisfy four mission profiles. Mission one is a polar mission that ranges from Chile to the South Pole and back to Chile, a total range of 6000 n.mi. at 100,000 ft with a 2500 lb payload. The second mission is also a polar mission, with an altitude of 70,000 ft and an increased payload of 4000 lbs. For the third mission, the aircraft will takeoff at NASA Ames, cruise at 100,000 ft carrying a 2500 lb payload, and land at Puerto Montt, Chile. The final mission requires the aircraft to take off at NASA Ames, cruise at 100,000 ft with a 1000 lb payload, make an excursion to 120,000 ft, and land at Howard AFB, Panama. Three missions require that a subsonic Mach number be maintained due to constraints imposed by the air sampling equipment. The aircraft need not be manned for all four missions. Three aircraft configurations have been determined to be the most suitable for meeting the above requirements. In the event that a requirement cannot be obtained within the given constraints, recommendations for proposal modifications are given. Author

N92-25591# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Flugabteilung.

THE DLR TEST AIRCRAFT IN FZ-BS VFW614/ATTAS, DORNIER DO228-101, MBB BO 105-S-3 [DIE DLR-VERSUCHSLUFTFAHRZEUGE IM FZ-BS, -VFW 614/ATTAS, DORNIER DO 228-101, MBB BO105 S-3]

HANS-L. MEYER In its Flight Test of Avionic and Air-Traffic Control Systems p 9-34 Jul. 1991 In GERMAN Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The different test aircraft used by DLR are described. The Dornier DO-228-101 is an all metal airplane with mid set wings and two turboprop engines. The fuselage has a rectangular cross section and is not pressurized. The reference flight trajectory can be very accurately measured with a view to the control of navigation and landing systems. The flying helicopter simulator BO-105 S-3 is highly maneuverable and contains controllable main and tail rotors. The flying simulator, ATTAS (Advanced Technologies Testing Aircraft Systems), was developed starting from a short range jet, the VFW 614, such that flight trajectories and maneuvers of other models can be tested and checked under flight conditions. ESA

N92-25594# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.

INTRODUCTION AND EXECUTION OF FLIGHT TESTS AT THE DLR [EINLEITUNG UND ABWICKLUNG VON FLUGVERSUCHEN IN DER DLR]

HELMUT BOTHE In its Flight Test of Avionic and Air-Traffic Control Systems p 57-70 Jul. 1991 In GERMAN Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The different test stands available for an efficient execution of flight tests are described. The onboard equipment comprises an airborne system for the reference flight path, avionics sensor systems, a data acquisition and transmission system, aeronautical radio systems, and an experimental cockpit. The ground equipment comprises a tracking radar, a laser radar, a kinotheodolite system, a telemetry receiver system with online data processing, a gyroscope test system, the air traffic simulator ATMOS, a ground test vehicle, and a high frequency radiation system. ESA

N92-25596# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.

TESTING OF AN EXPERIMENTAL FMS [ERPROBUNG EINES EXPERIMENTELLEN FMS]

VOLKMAR ADAM In its Flight Test of Avionic and Air-Traffic Control Systems p 85-104 Jul. 1991 In GERMAN Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The development of an Experimental Flight Management

System (EFMS) and the validation and testing of the EFMS functions in a given test environment are discussed. The present air traffic control problems can only be solved by an integrated Air Traffic Management (ATM) system. Therefore, new FMS functions must be developed and their efficiency demonstrated in a simulated scenario of the future situation. The EFMS presently being developed in the framework of the program PHARE (Program for Harmonized ATM Research in Eurocontrol) is flexible and easy to adapt to experimental requirements. The testing procedure of the EFMS in flight and in connection with air traffic simulation is outlined. ESA

N92-25714*# Sverdrup Technology, Inc., Cleveland, OH.
GRID GENERATION FOR A COMPLEX AIRCRAFT CONFIGURATION

JIM BRUNS /in NASA. Lewis Research Center, Workshop on Grid Generation and Related Areas p 17-27 Apr. 1992
 Avail: NTIS HC/MF A08

The procedure used to create a grid around the F/A-18 fighter aircraft is presented. This work was done for the NASA High Alpha Technology Program. As part of this program, LeRC is numerically and experimentally investigating the flow in the F/A-18 inlet duct at high angles of attack. A grid was needed which could be used to calculate both the external and internal flow around the F/A-18. The grid had to be compatible with the computational fluid dynamics (CFD) codes PARC3D and CFL3D. The programs used to create this grid were I3GVIRGO and GRIDGEN. A surface definition used to create the grid was obtained from McDonnell Aircraft Company (MCAIR) and was composed of numerous files each containing a point definition of a portion of the aircraft. These files were read into the geometry manipulation program I3GVIRGO, where they were modified and grouped into smaller GRIDGEN database files. Next, the block outlines and boundary conditions were specified in the GRIDBLOCK program. The GRIDGEN2D program was used to create the surface grid on the block faces, and GRIDGEN3D was used to create the full 3-D grid. Author

N92-25919*# General Electric Co., Cincinnati, OH. Aircraft Engines.

HIGH SPEED CIVIL TRANSPORT

R. L. MCKNIGHT /in NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems p 173-188 May 1992
 Avail: NTIS HC/MF A22

The design requirements of the High Speed Civil Transport (HSCT) are discussed. The following design concerns are presented: (1) environmental impact (emissions and noise); (2) critical components (the high temperature combustor and the lightweight exhaust nozzle); and (3) advanced materials (high temperature ceramic matrix composites (CMC's)/intermetallic matrix composites (IMC's)/metal matrix composites (MMC's)). Author

N92-25920*# Pratt and Whitney Aircraft, West Palm Beach, FL.
STRUCTURES TECHNOLOGY APPLICATIONS FOR THE NATIONAL AEROSPACE PLANE

T. E. LITTLE /in NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems p 189-208 May 1992
 Avail: NTIS HC/MF A22

The National AeroSpace Plane (NASP) presents a unique set of very complex structural problems that challenge our computational capabilities. Complex analyses are required in the conceptual design phase to achieve sufficient accuracy to address the extreme load conditions and to adequately evaluate vehicle weight. The computational capability must be available to perform these analyses in a rapid manner to accommodate the design process. Author

N92-25921*# Wright Lab., Wright-Patterson AFB, OH.
LARGE SCALE OPTIMIZATION USING ASTROS: AN OVERVIEW

VIPPERIA B. VENKAYYA /in NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems p 209-230 May 1992
 Avail: NTIS HC/MF A22

Interest in interdisciplinary systems is widespread around the world. A number of structural optimization systems are being developed and tested. Some examples are listed here. ASOP, FASTOP, and TSO are programs developed for the Air Force Flight Dynamics Laboratory during the seventies. These programs established the feasibility of integrating various disciplines. The program 'STARS' is basically a structural optimization system developed by the Royal Aircraft Establishment (RAE) in England. At present, it is being enhanced to include aeroelasticity. 'LAGRANGE' is an optimization system developed by MBB in Germany. ELFINI is a similar system developed in France. It is being marketed in the U.S. as well as other countries. The Automated STRuctural Optimization System (ASTROS) was developed for the Flight Dynamics Directorate of Wright Laboratory. The ASTROS system is described in viewgraph form. Author

N92-25922*# Virginia Univ., Charlottesville. Light Thermal Structures Center.

LIGHT THERMAL STRUCTURES AND MATERIALS FOR HIGH SPEED FLIGHT

EARL A. THORNTON /in NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems p 231-251 May 1992 Sponsored in part by Virginia Univ. Academic Enhancement Program (Contract NAG1-745; NAG1-1013)
 Avail: NTIS HC/MF A22

Over the last twenty years, unified viscoplastic constitutive models have evolved to meet this need. These constitutive models provide a means for representing a material's response from the elastic through the plastic range including strain-rate dependent plastic flow, creep, and stress relaxation. Rate-dependent plasticity effects are known to be important at elevated temperatures. The purpose of this paper is to describe computational and experimental research programs underway at the Light Thermal Structures Center focused on the investigation of the response of structures and materials to local heating. In the first part of the paper, finite element thermoviscoplastic analysis is highlighted. In the second part of the paper, the thermal-structures experimental program is outlined. Author

N92-25931*# Wright Lab., Wright-Patterson AFB, OH.

AIRFRAME LIFE PREDICTION

G. P. SENDECKYJ /in NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems p 431-445 May 1992
 Avail: NTIS HC/MF A22

The required research to develop improved life prediction methods for metallic and composite structures under severe thermomechanical loading must include the development of a verified thermoinelastic fracture criterion. There has been much work in this area with many fracture criteria being proposed. Due to the lack of adequate experimental verification none of them are widely accepted. Research must also be performed to develop and implement improved thermoinelasticity theories that properly model large temperature excursions and high temperature gradient. This research is required to provide confidence in the simpler theories currently used for thermoinelastic analysis. Finally, experimental data is needed to define the behavior of and damage accumulation process in thermoinelastic materials. Special emphasis must be placed on understanding failure mode transitions under thermomechanical loading conditions. Author

N92-25935*# General Electric Co., Cincinnati, OH.

COMPUTATIONAL STRUCTURES TECHNOLOGY ENGINE/AIRFRAME COUPLING

BRUCE C. MCCLINTICK /in NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems p 507-520 May 1992
 Avail: NTIS HC/MF A22

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Many aspects of engine/airframe coupling which are related to structures are examined. The generation and analysis is studied of full 3-D engine structures with regard to the design and operation of the engine under static load conditions. However, several problems arose which required the use of the three dimensional models under dynamic loads to more fully understand what was happening. Full 3-D engine structural models have been used on a regular basis to help understand dynamics related problems. One such problem, addressed herein, is engine related aircraft vibration. Engine related aircraft vibration is noise within the fuselage of the aircraft which can be both felt and heard. To effectively predict engine related aircraft vibration, the entire engine/airframe must be treated as a system. Author

N92-25995*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

AIRCRAFT OPTIMIZATION BY A SYSTEM APPROACH: ACHIEVEMENTS AND TRENDS

JAROSLAW SOBIESZCZANSKI-SOBIESKI May 1992 16 p
Proposed for presentation at the 18th ICAS Congress, Beijing, China, 20-25 Sep. 1992
(Contract RTOP 505-63-50-06)
(NASA-TM-107622; NAS 1.15:107622) Avail: NTIS HC/MF A03

Recently emerging methodology for optimal design of aircraft treated as a system of interacting physical phenomena and parts is examined. The methodology is found to coalesce into methods for hierarchic, non-hierarchic, and hybrid systems all dependent on sensitivity analysis. A separate category of methods has also evolved independent of sensitivity analysis, hence suitable for discrete problems. References and numerical applications are cited. Massively parallel computer processing is seen as enabling technology for practical implementation of the methodology.

Author

N92-26017*# Iowa State Univ. of Science and Technology, Ames. Dept. of Aerospace Engineering and Engineering Mechanics.

TRAJECTORY OPTIMIZATION FOR THE NATIONAL AEROSPACE PLANE Final Report, 1 May 1991 - 30 May 1992

PING LU Jun. 1992 46 p
(Contract NAG1-1255)
(NASA-CR-190355; NAS 1.26:190355) Avail: NTIS HC/MF A03

The primary objective of this research is to develop an efficient and robust trajectory optimization tool for the optimal ascent problem of the National Aerospace Plane (NASP). This report is organized in the following order to summarize the complete work: Section two states the formulation and models of the trajectory optimization problem. An inverse dynamics approach to the problem is introduced in Section three. Optimal trajectories corresponding to various conditions and performance parameters are presented in Section four. A midcourse nonlinear feedback controller is developed in Section five. Section six demonstrates the performance of the inverse dynamics approach and midcourse controller during disturbances. Section seven discusses rocket assisted ascent which may be beneficial when orbital altitude is high. Finally, Section eight recommends areas of future research.

H.A.

N92-26039# Naval Postgraduate School, Monterey, CA.
THE V-22 TILT ROTOR: A COMPARISON WITH EXISTING COAST GUARD AIRCRAFT M.S. Thesis

JAY D. MAHAFFEY Dec. 1991 118 p
(AD-A245843) Avail: NTIS HC/MF A06

The Coast Guard Office of Aviation Plans and Programs continues to receive inquiries from several sources about the service's intentions concerning the V-22 tilt rotor aircraft. Officially, decision makers acknowledge that tilt rotor capabilities could be readily adaptable to the service missions, but acquisition of the V-22 will not be contemplated unless the aircraft is first fielded by a Department of Defense component. This thesis serves as a preliminary inquiry into tilt rotor applications for the Coast Guard. The purpose of the study is to determine the implications of a favorable V-22 production decision on the Coast Guard's current

mix of aircraft. As background material, the history of tilt rotor development is reviewed, and the key economic issues at the center of the public policy debate likely to decide the V-22's future are outlined. Then, the V-22 Osprey is compared with each aircraft already in Coast Guard service. Both performance characteristics and costs are examined. Lastly, potential Coast Guard V-22 assimilation strategies are reviewed. GRA

N92-26155# Naval Postgraduate School, Monterey, CA.
SIMULATION OF A ROTORCRAFT IN TURBULENT FLOWS M.S. Thesis

ROBERT D. MORAN, JR. Sep. 1991 102 p
(AD-A245742) Avail: NTIS HC/MF A06

Accurate simulation of helicopters in an at-sea-shipboard environment is desired to provide realistic operating envelopes without incurring the enormous cost of real-time flight tests. This study examines the simulation of rotorcraft in turbulent flow by looking at previous attempts at helicopter-ship interfacing, current efforts in this area, and what will be needed in the future. Part of this study is devoted to the construction of an analytic model of the tunnel strike problem of the CH-46 Sea Knight helicopter that is based on measurements made over the flight deck of a model ship. A computer model was constructed, with the aim of modeling the 'tunnel strike' during engagement aboard AOR type ships. The remainder of the study is concerned with the simulation of the motion of a helicopter in the turbulent wake of a DD-963 class ship. Results show that a sixth order transfer function can filter white noise to accurately model the turbulence spectra at specific points along a helicopter glide path in the wake. While a tunnel strike could not be successfully modeled using DYSCO software, a simple blade-element program was developed to show the aerodynamic forces on the rotor blades in a specific flow field over an AOR class ship flight deck. That program shows the location and magnitude of the aerodynamic forces contributing to the flapping of the rotor blades, which results in the rotor blades impacting the fuselage. GRA

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

A92-38128
A NOVEL AVIONIC SENSOR FOR FLY-BY-LIGHT CONTROLS
G. L. ABBAS, M. DE LA CHAPELLE, F. DONES, D. L. MARTIN, C. R. PORTER, R. S. TEAL, and E. J. VERTATSCHITSCH (Boeing Defense and Space Group, Seattle, WA) Photonics Spectra (ISSN 0731-1230), vol. 26, no. 4, April 1992, p. 95, 96, 98, 100. refs

Copyright

A small-size, low-weight avionic sensor for fly-by-light controls with robust immunity to electromagnetic effects was developed using chirped intensity-modulated ladar fiber-optic sensing (LFOS) approach. The performance of the LFOS sensor was found to be better than that of an electrical sensor used for comparison, and no performance degradation was evident during several months of testing. Excellent performance potential with respect to multiplexing capability and fault-isolation capability is demonstrated. I.S.

A92-39561* National Aeronautics and Space Administration, Washington, DC.

GPS INTERFEROMETRIC ATTITUDE AND HEADING DETERMINATION - FLIGHT TEST RESULTS

FRANK VAN GRAAS and MICHAEL S. BRAASCH (Ohio University, Athens) IN: Institute of Navigation, Annual Meeting, 47th, Williamsburg, VA, June 10-12, 1991, Proceedings. Washington, DC, Institute of Navigation, 1991, p. 183-191. Research supported by

FAA. refs
(Contract NGR-36-009-017)

Methods and results for realtime pitch, roll, and heading determination of a dynamic flexible platform are presented. Consideration is given to a GPS attitude and heading determination system installed in Ohio University's Douglas DC-3 research aircraft. Signals from four antennas are processed by an Ashtech 3DF 24-channel GPS receiver. Data from the receiver are sent to a microcomputer for storage and further computations. Attitude and heading data are sent to a second computer for display on a software generated artificial horizon. Demonstration of this technique proves its candidacy for augmentation of aircraft state estimation for flight control and navigation as well as for numerous other applications, such as reliable aircraft state estimation, measurement of structural flexing of large space structures, synthetic aperture radar, aerial photogrammetry, pointing systems, spacecraft attitude control, rendezvous and docking, and road mapping. C.A.B.

A92-39570

THE EVOLUTION OF MILITARY GPS TECHNOLOGY INTO THE NAVCORE V RECEIVER ENGINE

STEWART P. TEASLEY (Rockwell International Corp., Dallas, TX) IN: Institute of Navigation, Annual Meeting, 47th, Williamsburg, VA, June 10-12, 1991, Proceedings. Washington, DC, Institute of Navigation, 1991, p. 449-456.

Methods of developing low-cost commercial GPS receivers to take advantage of critical technologies without bearing the cost burdens of military manufacturing and test requirements are explored. Issues addressed include custom integrated circuit development, software commonality, and manufacturability to commercial standards. It is concluded that significant performance improvements can be achieved in commercial GPS receivers by using an optimal infusion of military technology and proven software legacy. C.A.B.

A92-39952

DESIGN CONSIDERATIONS FOR A GENERIC E.V.M.

SHERYL SMITH-BAILEY (Endevco, San Juan Capistrano, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 8 p.
(SAE PAPER 912095) Copyright

A generic engine vibration monitoring (EVM) unit for monitoring vibration on all gas turbine engines is considered, focusing on large commercial aircraft engines. This generic EVM is characterized by fleet compatibility, reduction in spares, and ground support equipment. Attention is also given to input/output requirements and the hardware and software trade-off decisions. O.G.

A92-39963

ELS FOR THE A340

FRANCOIS GOUDENOVE (Aerospatiale, Paris, France) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 7 p.
(SAE PAPER 912111) Copyright

The Electronic Library System is a general designation for ground and airborne systems in charge of providing Aircraft operators with the information they need. For A330/A340 aircraft, the airborne system is LRU based and the flexibility required by Airlines is provided through a modular configuration. The Airborne Electronic Library System Man-Machine interface is designed to be consistent with the general cockpit design. In particular, the flight crew display devices are integrated within the sliding tables in front of each pilot station. Author

A92-39980* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.

DEVELOPMENT OF A PNEUMATIC HIGH-ANGLE-OF-ATTACK FLUSH AIRDATA SENSING SYSTEM

STEPHEN A. WHITMORE (NASA, Flight Research Center, Edwards, CA) SAE, Aerospace Technology Conference and

Exposition, Long Beach, CA, Sept. 23-26, 1991. 33 p. Previously announced in STAR as N92-11994. refs

(SAE PAPER 912142) Copyright

A nonintrusive high-angle-of-attack flush airdata sensing system was installed and flight tested in the F-18 High Alpha Research Vehicle. This system consists of a matrix of 25 pressure orifices arranged in concentric circles on the nose of the vehicle to determine angles of attack and sideslip, Mach number, and pressure altitude. During the course of the flight tests, it was determined that satisfactory results could be achieved using a subset of just nine ports. Author

A92-39981

AIR DATA MEASUREMENT FOR HYPERSONIC VEHICLES

EARL T. BENSER (Honeywell Systems and Research Center, Minneapolis, MN) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 11 p. refs
(SAE PAPER 912143) Copyright

Hypersonic air data measurement requirements are reviewed, and techniques for the measurement of air data parameters for vehicle flight and propulsion control are presented. It is noted that the air data measurement system must be able to operate within the stressing operational environment expected at the vehicle surfaces or within the propulsion subsystem and to provide rapid update rates and spatially resolved measurements. The selection of an air data measurement technique for a particular application will take into account the performance required and the implementation constraints for the specific application. O.G.

A92-39982

ON UPSETS OF ANALOG PORTIONS OF DIGITAL FLIGHT CONTROL SYSTEMS DUE TO ELECTROMAGNETIC INTERFERENCE

BRUCE T. CLOUGH (USAF, Wright Laboratory, Wright-Patterson AFB, OH) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 14 p. refs
(SAE PAPER 912144)

The types of upsets that can happen within a digital flight control system (DFCS) when operating in an intense electromagnetic interference (EMI) environment are characterized using the test data for the analog inputs of DFCS. It is concluded that, to cause upset, waveforms demodulated prior to system input must have modulations lying in the passband of the DFCS. Analog DFCS inputs are susceptible to average, vs peak, voltages for system upsets. Analog sensors requiring AC excitation are more sensitive to modulations near, or at, the excitation frequency. Actuator output averaging mitigates the EMI effects much better than the practice of dedicating a certain channel to drive a certain control surface. It is pointed out that the analog sections of a modern DFCS will not be upset by radar or other high power pulsed radio-frequency sources. O.G.

A92-40014

ENHANCED VISION SYSTEM OPTION ON FUTURE AIRCRAFT

PAUL R. LECKMAN (Boeing Commercial Aircraft Group, Seattle, WA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 10 p. refs
(SAE PAPER 912204) Copyright

An 'enhanced vision system' (EVS) concept has been developed in connection with studies of future autonomous aircraft whose dependence on ground-based navigational aids is reduced or entirely eliminated. An EVS displays sensor-derived information to a pilot via HUD, facilitating such tasks as the visualization of runway environments during IFR operations. System components are integrated in such a way as to anticipate the control tasks that must be accomplished, in the framework of all relevant human factors. It is anticipated that pilot avoidance of runway incursions in night/low-visibility conditions could be substantially improved. The EVS concept is projected to a future High Speed Civil Transport's 'synthetic vision system'. O.C.

A92-40015

94 GHZ MMW IMAGING RADAR SYSTEM

YAIR ALON and LON ULMER (Lear Astronics Corp., Santa Monica, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 16 p. (SAE PAPER 912208) Copyright

The 94 GHz MMW airborne radar system that provides a runway image in adverse weather conditions is now undergoing tests at Wright-Patterson Air Force Base (WPAFB). This system, which consists of a solid state FMCW transceiver, antenna and digital signal processor, has an update rate of 10 times per second, 0.35 deg azimuth resolution and up to 3.5 meter range resolution. The radar B scope (range versus azimuth) image, once converted to C scope (elevation versus azimuth), is compatible with the standard TV presentation and can be displayed on the Head Up Display (HUD) or Head Down Display (HDD) to aid the pilot during landing and takeoff in limited visibility conditions. Author

A92-40017

SIKORSKI (S-76) HIGH INTENSITY RADIATED FIELDS (HIRF) TEST

JERRY T. BLAIR (Scientech, Inc., Idaho Falls, ID) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 24 p.

(SAE PAPER 912214) Copyright

The FAA's Technical Center at Atlantic City has instituted a HIRF research program in response to concern over the disruptive induced cable current damage to which electronic systems used by commercial aircraft may be susceptible. Attention is presently given to the HIRF testing conducted aboard an S-76 helicopter, in view of the intrinsically greater amount of nonelectric field-reflective surface area (cockpit and cabin transparencies) possessed by rotorcraft, relative to fixed-wing aircraft. The disruption of a digital fuel-flow indicator is noted to be an indication of unanticipated susceptibility to HIRF effects. O.C.

A92-40262

BIAS OF AN OPTICAL PASSIVE RING-RESONATOR GYRO CAUSED BY THE MISALIGNMENT OF THE POLARIZATION AXIS IN THE POLARIZATION-MAINTAINING FIBER RESONATOR

KOICHI TAKIGUCHI and KAZUO HOTATE (Tokyo, University, Japan) Journal of Lightwave Technology (ISSN 0733-8724), vol. 10, no. 4, April 1992, p. 514-522. refs

Copyright

An analysis is conducted of the optical passive ring-resonator gyro bias generated by the misalignment of the polarization axis, in the resonator that is formed by the polarization-maintaining fiber. This bias can be suppressed by setting the fiber polarizers at the lead portions of the resonator. It is also established that polarizer parameter requirements are severe, when their goal is high-performance aircraft navigation. O.C.

A92-40883

WINDSHEAR DETECTION

Aerospace Engineering (ISSN 0736-2536), vol. 12, no. 5, May 1992, p. 15-17.

Copyright

A review is presented of the current status involving development and certification of predictive windshear systems. Particular attention is given to systems based on passive IR technology which can provide advance warning of both microburst-generated windshear and clear-air disturbance. Passive IR is also applicable to the detection of damaging volcanic ash and jetstream localization. R.E.P.

A92-24689*# Computer Sciences Corp., Hampton, VA.

ADVANCED TRANSPORT OPERATING SYSTEM (ATOPS) CONTROL DISPLAY UNIT SOFTWARE DESCRIPTION

CHRISTOPHER J. SLOMINSKI, MARK A. PARKS, KELLY R. DEBURE, and WILLIAM J. HEAPHY Jan. 1992 347 p (Contract NAS1-19038; RTOP 505-64-13-11) (NASA-CR-189606; NAS 1.26:189606) Avail: NTIS HC/MF A15 CSCL 09B

The software created for the Control Display Units (CDUs),

used for the Advanced Transport Operating Systems (ATOPS) project, on the Transport Systems Research Vehicle (TSRV) is described. Module descriptions are presented in a standardized format which contains module purpose, calling sequence, a detailed description, and global references. The global reference section includes subroutines, functions, and common variables referenced by a particular module. The CDUs, one for the pilot and one for the copilot, are used for flight management purposes. Operations performed with the CDU affects the aircraft's guidance, navigation, and display software. Author

N92-25592# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.

THE BASIC MEASURING TECHNICAL EQUIPMENT OF THE DLR TEST AIRCRAFT [DIE MESSTECHNISCHE GRUNDAUSRUESTUNG DER DLR-VERSUCHSFLUGZEUGE]

HELMUT BOTHE In its Flight Test of Avionic and Air-Traffic Control Systems p 35-48 Jul. 1991 In GERMAN

Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The measuring equipment systems of the ATTAS (Advanced Technologies Testing Aircraft Systems) and the DO 228 are described. The main aim of the basic equipment is to determine the necessary parameters, and to filter, prepare, adapt, and process the signals, via a comprehensive sensor system. The basic equipment of the ATTAS and the DO 228 is largely compatible, but the ATTAS equipment is substantially more extensive, while the Dornier equipment is more mobile and can be installed in other aircraft without much effort. An integrated pulse code modulation (PCM) system digitizes the analog sensor signals and provides a sequential PCM data flow. The PCM data can be transmitted to ground station. ESA

N92-25598# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.

PALLET FOR HELICOPTER TESTING INSTRUMENTATION [PALETTE ZUR HUBSCHRAUBER-VERSUCHSINSTRUMENTIERUNG]

GEORG HAEHNLEIN and PETER JAENSCH In its Flight Test of Avionic and Air-Traffic Control Systems p 114-153 Jul. 1991 In GERMAN

Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The conceptualization, realization, and application of a helicopter experimental platform are presented. The different factors influencing the helicopter system were identified and optimized with respect to higher mission requirements and an improved execution of the mission. The most varied user programs were conducted using a BO-105-S3 helicopter and the experience was exceptionally positive. The systems reliability is high and no failures occurred. The data acquisition components of the system were actualized several times. According to the concept, the hardware and software components of the data acquisition system are in a state of permanent technological upgrading. ESA

N92-25603# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.

ARRANGEMENTS AND METHODS FOR THE SURVEY OF AIRCRAFT RADIO COMPONENTS AND SYSTEMS [EINRICHTUNGEN UND METHODEN ZUR VERMESSUNG VON FLUGFUNKKOMponentEN UND -SYSTEMEN]

JUERGEN TETZLAFF In its Flight Test of Avionic and Air-Traffic Control Systems p 247-259 Jul. 1991 In GERMAN

Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

A flight survey system for the inflight measurement of RF components and systems (antenna radiation patterns, radar reflection characteristics) was developed. The modular measuring systems are automated to reduce the time and cost requirements. After an online data evaluation, the measurements provide the

quantity to be analyzed as a function of an angle (aspect angle) which is correlated to the aircraft coordinate system. The measuring equipment is calibrated before the flight. ESA

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

A92-36888

ANALYTICAL CONDITION INSPECTION AND EXTENSION OF TIME BETWEEN OVERHAUL OF F3-30 ENGINE

M. NAKAO (Japan Defense Agency, Tokyo), M. IKEYAMA (Ishikawajima-Harima Heavy Industries Co., Ltd., Tanashi, Japan), and S. ABE (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 114, no. 2, April 1992, p. 196-200. refs
(ASME PAPER 91-GT-277) Copyright

F3-30 is the low-bypass-ratio turbofan engine developed to power the T-4 intermediate trainer. The program to extend time between overhaul (TBO) of the F3-30 has been running. Analytical condition inspection (ACI) and accelerated mission testing (AMT) were conducted to confirm sufficient durability to extend TBO. Most deteriorations of parts and performance due to AMT were also found by ACI after field operation with approximately the same deterioration rate. On the other hand, some deteriorations were found by ACI only. These results show that ACI after field operation is also necessary to confirm the TBO extension, although AMT simulates the deterioration in field operations very well. The deteriorations that would be caused by the field operation during one extended-TBO were estimated with the results of ACI and AMT, and it was concluded that the F3-30 has sufficient durability for TBO extension to the next step. Author

A92-36889

OPTIMAL MEASUREMENT AND HEALTH INDEX SELECTION FOR GAS TURBINE PERFORMANCE STATUS AND FAULT DIAGNOSIS

A. STAMATIS, K. MATHIOUDAKIS, and K. PAPAILIOU (Athens, National Technical University, Greece) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 114, no. 2, April 1992, p. 209-216. refs
(ASME PAPER 91-GT-294) Copyright

A method for defining the health estimation parameters and the measurements that must be used when a monitoring system for an engine is being set up is presented. The particular engine layout, the available measuring instruments, and the accuracy by which data can be collected are the factors taken into account. The particular health condition estimation factors that have to be used are defined as a function of this information and the desired depth of fault identification. A fast selection procedure based on the method of singular value decomposition is presented. The uncertainty in the estimations is also derived, thus giving an additional element of information useful for decision making. The proposed method, together with adaptive performance modeling, provides a self-sufficient tool, which can be applied for setting up and subsequent exploitation of a health monitoring expert system. The advantage of the procedure is that it provides a frame of application, allowing quick implementation in a new engine of interest, other than the ones previously considered. Author

A92-36890

AN APPROACH FOR EVALUATION OF GAS TURBINE DEPOSITION

R. A. WENGLARZ (General Motors Corp., Allison Gas Turbine Div., Indianapolis, IN) ASME, Transactions, Journal of Engineering

for Gas Turbines and Power (ISSN 0742-4795), vol. 114, no. 2, April 1992, p. 230-234. Research supported by General Motors Corp. and DOE. refs

(ASME PAPER 91-GT-214) Copyright

An approach for estimating deposition in gas turbines is described. This approach extrapolates deposition data from lower cost experiments than turbine engine or cascade tests. The purpose is a method to screen candidate fuels and turbine protection methods so that only the most promising need be evaluated in turbine tests. The deposition approach is applied to estimate deposition maintenance intervals for a tested fuel, evaluate benefits of hot gas cleanup, and provide fuel screening criteria. Author

A92-36891

AN INVESTIGATION IN THE VARIANCE IN PARTICLE SURFACE INTERACTIONS AND THEIR EFFECTS IN GAS TURBINES

A. HAMED (Cincinnati, University, OH) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 114, no. 2, April 1992, p. 235-241. Research supported by DOE. refs
(Contract NSF CTS-90-12309)
(ASME PAPER 91-GT-380) Copyright

This work presents the results of a study conducted to investigate particle surface interaction characteristics and their effects on the particle dynamics and blade erosion in axial flow gas turbines. The particle restitution velocities measured experimentally using Laser Doppler Velocimetry in a special tunnel are analyzed using statistical methods. The resulting distribution functions of the rebounding particle velocities after surface impacts are introduced in the particle trajectory simulations through the turbine blade passages, using a methodology that combines particle dynamics computations in a probabilistic model. The presented results for the simulated ash particle dynamics demonstrate the effect of the experimentally measured variance in the particle restitution characteristics on the particle surface impacts, and the associated blade erosion in an axial flow turbine. Author

A92-36892

COATING EFFECT ON PARTICLE TRAJECTORIES AND TURBINE BLADE EROSION

W. TABAKOFF and M. METWALLY (Cincinnati, University, OH) (International Symposium and Exposition on Gas Turbines in Cogeneration, Repowering, and Peak-Load Power Generation, 5th, Budapest, Hungary, Sept. 3-5, 1991) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 114, no. 2, April 1992, p. 250-257. Research supported by DOE. refs
Copyright

Coal ash particle dynamics and resulting blade erosion phenomena are presently studied for both coated and uncoated blades of a two-stage axial flow gas turbine. A quasi-3D flow solution is obtained for each blade row as a basis for accurate computation of particle trajectories, and the erosion models for both superalloy and coatings are derived from erosion data obtained by testing them in a high temperature erosion wind tunnel. The results of the study encompass 3D particle trajectories and blade-impact locations; attention is given to the distributions of erosion rate, and impact frequency, velocity, and angle, for both superalloy and coating. The coating significantly affects both blade erosion and material deterioration behavior. O.C.

A92-36977

ADVANCED PROPULSION SYSTEMS FOR LARGE SUBSONIC TRANSPORTS

N. J. PEACOCK and J. H. R. SADLER (Rolls-Royce, PLC, Derby, England) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 3, May-June 1992, p. 703-708. Previously cited in issue 20, p. 3091, Accession no. A89-46861. refs
Copyright

A92-37390

ON PERFORMANCE CALCULATION OF CENTRIFUGAL DISH ATOMIZER COMBUSTOR

CHANGLIN LI and MING TANG (Northwestern Polytechnical University, Xian, People's Republic of China) Northwestern Polytechnical University, Journal (ISSN 1000-2758), vol. 10, no. 2, April 1992, p. 140-146. In Chinese. refs

A method for calculating the performance of a centrifugal disk atomizer combustor is presented. The center streamline of the centrifugal dish atomizer combustor is curved. The air flow in the complex second path is simplified as three branch flows. The loss of local pressure is calculated by considering both parallel and series cases. In existing methods only the parallel case is considered. The novelty of the present method is that dissociation loss and expanding loss are considered. These features make it possible to use basic equations to calculate the mass distribution, pressure loss, flow parameters, and wall temperature of the combustor with a curved center stream line. A WZ-6 engine combustor is taken as an illustrative example. The calculation results are in good agreement with the test results of water flow simulation. Thus the present method can be used for evaluating the performance of a centrifugal dish atomizer combustor. P.D.

A92-37423

AN ESTIMATE OF THE INFLUENCE OF THE COMPRESSOR STABILITY MARGIN ON THE PICK-UP TIME OF A TURBOJET ENGINE

M. ORKISZ (Air Force Academy, Deblin, Poland) Polish Academy of Sciences, Institute of Fundamental Technological Research, Engineering Transactions (ISSN 0035-9408), vol. 39, no. 2, 1991, p. 191-206. refs

Copyright

The relations are derived enabling to estimate the acceleration time of the turbojet engine rotor set. The terms are established allowing for the determination of the effect of individual operational and structural engine parameters upon the time needed for acceleration of the rotor system. Influence of the economic and optimum ranges of operation upon that time is also analyzed.

Author

A92-37424

AN ESTIMATE OF THE INFLUENCE OF THE COMPRESSOR STABILITY MARGIN ON THE THRUST OF A TURBOJET ENGINE

M. ORKISZ (Air Force Academy, Deblin, Poland) Polish Academy of Sciences, Institute of Fundamental Technological Research, Engineering Transactions (ISSN 0035-9408), vol. 39, no. 2, 1991, p. 207-219. refs

Copyright

A computational model is developed which makes it possible to determine the thrust of a turbojet engine with allowance for the stability margin of the compressor under conditions of steady state operation. Analytical expressions are obtained for determining the stability margin of the compressor within the optimum and economy compression ratio ranges. By using these expressions, an analysis of the maximum efficiency of a power plant during a combat mission can be performed. V.L.

A92-37824

THE THERMODYNAMIC APPROACH IN THE STUDY OF LARGE SYSTEMS - APPLICATION TO HIGH-VELOCITY AIRBREATHING PROPULSION [L'APPROCHE THERMODYNAMIQUE DANS L'ETUDE DES GRANDS SYSTEMES - APPLICATION A LA PROPULSION AEROBIE A GRANDE VITESSE]

M. BARRERE (ONERA, Chatenay-Malabry, France) and J. VANDENKERCKHOVE (VDK System, Brussels, Belgium) (Conseil Scientifique de la Defense, Reunion sur l'Espace, Ecole Polytechnique, Palaiseau, France, Nov. 7, 1991) Revue Scientifique et Technique de la Defense (ISSN 0994-1541), no. 15, 1st Quarter, 1992, p. 73-85. In French. refs

Copyright

The application of a high-velocity airbreathing propulsion system

as a guideline for research on complex thermal systems is presented. The thermodynamically optimized ramjet cycle attains optimum compression by the addition of energy from the combustion process. The optimization indicates that the critical flight velocity, using hydrogen fuel, is of the order of 2 km per sec. Hydrogen, with its low molar volume, is an ideal fuel for propulsion as the ramjet operates at rich mixtures that increase with velocity, resulting in increased performance. The thermal efficiency of the propulsion system is improved by preheating the fuel utilizing a part of the air's kinetic energy. R.E.P.

A92-38025

RESEARCH AND DEVELOPMENT OF TURBOFAN ENGINE FOR SUPERSONIC AIRCRAFT

SATOSHI YASHIMA (Ishikawajima-Harima Engineering Review (ISSN 0578-7904), vol. 32, no. 1, Jan. 1992, p. 1-6. In Japanese. refs

A turbofan engine with an afterburner called IHI-17 was designed and manufactured for research on a powerplant of a supersonic aircraft. Although the engine size is relatively small, the fighter engine specification was applied to its design. Various engine tests have been carried out since 1988 and component rig tests were also executed. Such technologies as three-dimensional CFD for the compressor and the turbine aerodynamic designs, air blast fuel atomizer for the high temperature combustor, an afterburner and FADEC have been developed through this program. New materials like single crystal and powder metallurgy were applied to the turbine and new manufacturing technologies like the deep chemical milling duct and the machined ring combustion liner were also developed. The engine has demonstrated its target performance and system integration technologies of the afterburner engine have been obtained. Author

A92-38267

A DYNAMIC DIGITAL MODEL FOR THE TURBOJET WITH PULSE-MONITORED FUELLER

DIYI TAND and YUANHU CAI (Northwestern Polytechnical University, Xian, People's Republic of China) (Journal of Aerospace Power, vol. 4, Apr. 1989, p. 137-140, 194) IN: Aerospace - Collected translations of selected papers. Xian, People's Republic of China, Northwestern Polytechnical University, 1991, 8 p. Translation. Previously cited in issue 20, p. 3089, Accession no. A89-45559. refs

A92-39309

ENGINE RELIABILITY

PETER D. VINALL (Civil Aviation Authority, Gatwick, England) IN: Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 18.1-18.14. Copyright

This report analyzes the reliability of aircraft engines against safety targets set in the context of airworthiness safety goals of the aircraft as a whole. Some examples illustrate experience that has led to changes in certification requirements aimed at attaining higher standards, but which also indicate the inherent difficulties of assuring that available data are correctly interpreted so that such changes do not inadvertently give rise to a reduction in safety. Particular examples are given to illustrate both the degree of past successes and the potential for introducing unintentional traps in the effort to improve the standards in light of experience and advances in design. R.E.P.

A92-39951

THE DEVELOPMENT AND INTEGRATION OF AN ENGINE MONITORING SYSTEM FOR THE F-14A+/D SUPER TOMCAT

MICHELE R. NIERENBERG (Grumman Corp., Grumman Aircraft Systems Div., Bethpage, NY) and ANDREW HESS (U.S. Navy, Naval Air Systems Command, Washington, DC) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 11 p.

(SAE PAPER 912094) Copyright

A development history and current status evaluation are presented for the F-14A+/D Super Tomcat engine monitoring system, through which numerous benefits have been realized. These benefits encompass reduced aircraft downtimes, obviated troubleshooting procedures, reduced maintenance costs, and the tracking of such critical engine problems as combustion-chamber burnthrough. The system tracks any one of 69 faults from occurrence to resolution, eliminating the use of ground-support equipment in many cases. O.C.

A92-39993

APPLICATION OF A DOUBLE ACTUATOR ELECTRONIC FUEL CONTROL UNIT ON A SMALL GAS TURBINE ENGINE

A. I. GEORGANTAS, T. KREPEC, and R. M. H. CHENG (Concordia University, Montreal, Canada) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 10 p. refs
(SAE PAPER 912160) Copyright

This paper investigates the performance of a double actuator electronic fuel control unit, when installed on a gas turbine engine. The validated mathematical model of the unit is linked to a quasi-linear engine mathematical model. A combination of two operating modes of the unit is used to improve the fuel delivery characteristics. Acceleration and maximum speed governing of the engine are simulated. Two control strategies are investigated. In the first, the fuel flow rate and the engine speed are used as feedback signals. In the second, the N-Dot control, which eliminates the need for fuel flow feedback during engine acceleration, is studied. Author

A92-39995

DISTRIBUTED HEALTH MANAGEMENT SYSTEMS TECHNOLOGY FOR FUTURE PROPULSION CONTROL SYSTEMS

J. WALD, J. SCHOESS, and G. HADDEN (Honeywell, Inc., Minneapolis, MN) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 11 p. refs
(SAE PAPER 912167) Copyright

Advances in the design and development of distributed health management systems for spacecraft propulsion control are reviewed. The use of a hierarchy of building blocks in smart and distributed sensors is reviewed, and health management and maintenance using smart sensor networks is examined. Algorithm design for health management and maintenance diagnostics is discussed. C.D.

A92-39998

THE USE OF HIGH VOLTAGE DIRECT CURRENT IN AIRCRAFT ELECTRICAL SYSTEMS - A NAVY PERSPECTIVE

ED TAYLOR, DON CROKE, and ERIC SPECK (U.S. Navy, Naval Air Test Center, Patuxent River, MD) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 13 p. refs
(SAE PAPER 912173) Copyright

The Naval Air Systems Command has established a working group to examine all aspects of the development, implementation, and use of high-voltage dc (HVDC) aircraft electrical power systems, which promise substantial improvements related to electrical system simplification, reliability, and weight reduction. The working group has given attention to prospective HVDC performance, weight, efficiency, avionics design, safety, logistics, reliability, distribution components, EMC, and technical risk. A new technology testbed is needed to furnish cooperative and independent evaluations and validations of candidate HVDC concepts. O.C.

A92-40001

FUTURE MILITARY APU REQUIREMENTS

EDWARD DURKIN (USAF, Wright Laboratory, Wright-Patterson AFB, OH) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 9 p. refs
(SAE PAPER 912176) Copyright

The upgrades required for the auxiliary power units (APUs) of next-generation tactical aircraft are examined. The weight,

performance, and mission profile of emerging multirole fighters (MFs) are estimated, and APU technologies are described which meet the anticipated requirements of the aircraft. The design requirements of the APU for the MF are listed as: (1) 400-hp sea-level power rating; (2) power density of 400 hp/cu ft; and (3) 200 hp available within 2 sec for in-flight emergencies at up to 50,000 ft. The APU is expected to function as an emergency power unit, so the integrated power unit is defined according to thermodynamic parameters. Attention is given to the severe temperature gradients expected for the turbine blades and the combustor. Life-cycle cost benefits are examined for the APU defined, and it is concluded that a compact integrated power unit is needed that maximizes power density and common components. C.C.S.

A92-40002

CHALLENGING POWER-DENSITY REQUIREMENTS FOR FUTURE FIGHTER APUS

COLIN RODGERS and JACK SHEKLETON (Sundstrand Power Systems, San Diego, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 15 p. refs
(Contract F33615-87-C-2808)
(SAE PAPER 912177) Copyright

Research is reviewed on the development of the technologies for an advanced-components auxiliary power unit (ACAPU) for fighter aircraft providing operation at up to 50,000 ft. The technical requirements of the ACAPU call for: (1) 400-hp output; (2) 5,000 hrs mean time between failures; (3) start-ups attaining 200 hp within 2 sec; and (4) built-in containment for trihub burst at 120 percent of design speed. An advanced-technology dual-mode airbreathing and nonairbreathing configuration is studied, and the vortex-stabilized and 'Sidewinder' combustors are compared for the airbreathing application. The ACAPU incorporates novel technologies including: (1) the 'Sidewinder' fuel-lean AB combustor with a high heat-release rate; (2) high-temperature monolithic ceramic and metallic turbines; (3) a fuel-rich NAB combustor; (4) a two-stage mixed-flow axial turbine; and (5) a high-pressure-ratio two-stage integral bleed compressor. C.C.S.

A92-40003

270-VDC/HYBRID 115-VAC ELECTRIC POWER GENERATING SYSTEM TECHNOLOGY DEMONSTRATOR EVOLUTION TO A DUAL-CHANNEL, MORE ELECTRIC AIRCRAFT TECHNOLOGY DEVELOPMENT TESTBED

R. E. NIGGEMANN, S. PEECHER, and G. I. ROZMAN (Sundstrand Aerospace, Rockford, IL) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 8 p. refs
(SAE PAPER 912183) Copyright

Transient performance data are presented for a 270-V dc/hybrid 115-V ac electrical power generating system (EPGS) applicable to the electromechanically actuated power systems of future 'more electric aircraft' (MEA). Many proposed MEA components and/or subsystems act as negative impedance nonlinear or regenerative loads, and can significantly affect EPGS power quality and stability margins. The EPGS is being expanded to encompass two power-generation/distribution channels, two 115-V ac 400-Hz inverters, an environment-control system, a 5-horsepower electromechanical actuator, a 270-V dc resistive load bank, and a PC-based generator/system-control unit. O.C.

A92-40005

HIGH SPEED CIVIL TRANSPORT ELECTRICAL POWER SYSTEM TECHNOLOGY REQUIREMENTS

EDWARD WOODS, J. (Boeing Co., Seattle, WA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 10 p.
(SAE PAPER 912185) Copyright

The Boeing Company is investigating a High Speed Civil Transport (HSCT) aircraft which will transport 300 passengers at speeds up to Mach 2.4. Such a high speed, high altitude aircraft presents unique environmental and safety requirements. The aircraft electrical power system configuration must provide the required redundancy and reliability necessary to supply power for

fly-by-wire flight control buses as well as other aircraft loads. Emergency power backup must be considered for various power failure conditions. This paper presents some of the issues affecting the electrical power system design, and some of the possible solutions which will be considered. Author

A92-40006

ADVANCED POWER GENERATION SYSTEMS FOR MORE ELECTRIC AIRCRAFT

MICHAEL J. CRONIN (Advanced Aeronautic Systems, Encino, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 16 p. refs (SAE PAPER 912186) Copyright

A development status and technological feasibility evaluation is conducted for the expansion of electromechanically-actuated (EMA) tasks aboard prospective commercial and military aircraft, in direct replacement of current hydraulic and pneumatic systems. A major problem identified lies in the ineluctable powering of the generator that constitutes the heart of an all-electric aircraft by an intrinsically variable-speed gas turbine engine; feasible solutions of this speed-mismatch problem are identified and evaluated in the context of foreseeable EMA configurations for airliners and tactical aircraft. O.C.

A92-40007

AUXILIARY POWER SYSTEM REQUIREMENTS FOR COMMERCIAL AIR TRANSPORTS - PAST, PRESENT AND FUTURE

M. P. MILLER and C. E. HIX (Boeing Commercial Airplane Group, Seattle, WA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 9 p. refs (SAE PAPER 912188) Copyright

Increasing demands for reliable airframe electrical and pneumatic power, fuel and weight efficiency, reduced crew workload, and environmental regulation compliance, have raised the importance of commercial aircraft APUs; the APU is an especially critical factor in extended range twin-engined aircraft requiring emergency backup power. The present development history and current development status evaluation for EPU projects future technology requirements and gives attention to APU engine-starting requirements, weight and noise reduction and fuel consumption minimization criteria, and reliability and maintainability requirements. O.C.

A92-40008

SECONDARY POWER SYSTEM PRELIMINARY DESIGN

RICHARD ULLYOTT (Pratt & Whitney Canada, Longueuil) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 19 p. refs (SAE PAPER 912189) Copyright

Commercial gas turbine APU requirements are in many respects more demanding than those for propulsion engines of a similar power level. The successful modern APU design must provide high reliability and durability in a flight weight package which also satisfies diverse and often conflicting performance requirements. The preliminary design phase represents the first crucial step toward meeting these objectives. This paper examines how the primary APU requirements influence turbomachinery configuration selection, and then flow down through the preliminary design process into individual APU component and subsystem design criteria, using a load-compressor APU example. Author

A92-40013

SINGLE LEVER POWER MANAGEMENT OF TURBOPROP ENGINES

L. C. PREVALLET (Allied-Signal Aerospace Co., Garrett Engine Div., Phoenix, AZ) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 9 p. (SAE PAPER 912200) Copyright

The 'single lever' power-management system for the TPF351-20 engine, as applied to the CBA123 aircraft, is a significant improvement over past turboprop engine power management systems. The use of a full-authority digital engine control (FADEC)

has yielded improvements in operability and reductions in pilot workload, in addition to enhancements of engine maintainability. As the pilot transitions from takeoff to climb to cruise, the FADEC recalculates its target engine torque for each of these conditions and automatically rescales the power-lever quadrant; the pilot need never adjust the power lever, once it has been placed in the 'power set' position. O.C.

A92-40144

REACTIVE MIXING LAYER BETWEEN PRESSURE REFLECTING BOUNDARIES

J. P. CHOLLET (Grenoble, Institut de Mecanique, France) and R. J. GATHMANN (Grenoble, Institut de Mecanique; SNECMA, Centre de Villaroche, Moissy-Cramayel, France) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 23-5-1 to 23-5-6. Research supported by CNRS. refs

Supersonic mixing layers develop instabilities when they are confined between rigid pressure reflecting boundaries. A direct numerical simulation is performed for two- as well as three-dimensional spatial calculations of nonstationary reactive gas flows. Cellular detonation is used as a test case and simulations are calculated for flows between rigid flat plates. Chemical reactions are also considered in order to possibly deal with turbulent combustion in high speed aircraft scramjet engines. Author

A92-40151* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

EFFECT OF TABS ON THE EVOLUTION OF AN AXISYMMETRIC JET

K. B. M. Q. ZAMAN (NASA, Lewis Research Center, Cleveland, OH), M. SAMIMY, and M. F. REEDER (Ohio State University, Columbus) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 25-5-1 to 25-5-6. Previously announced in STAR as N91-27159. refs

The effect of vortex generators, in the form of small tabs at the nozzle exit, on the evolution of an axisymmetric jet was investigated experimentally over a jet Mach number range of 0.34 to 1.81. The effects of one, two, and four tabs were studied in comparison with the corresponding case without a tab. Each tab introduced an indentation in the shear layer, apparently through the action of streamwise vortices which appeared to be of the trailing vortex type originating from the tips of the tab rather than of the necklace vortex type originating from the base of the tab. The resultant effect of two tabs, placed at diametrically opposite locations, was to essentially bifurcate the jet. The influence of the tabs was essentially the same at subsonic and supersonic conditions indicating that compressibility has little to do with the effect. Author

A92-40548

VIBRATION ANALYSIS OF GAS TURBINES BY AN INTELLIGENT KNOWLEDGE-BASED SYSTEM

R. J. ALLWOOD (Loughborough University of Technology, England) and P. I. CHRISTIE (Rolls-Royce, PLC, Bristol, England) Institution of Mechanical Engineers, Proceedings, Part G - Journal of Aerospace Engineering (ISSN 0954-4100), vol. 205, no. G2, 1991, p. 115-121. Research supported by ALVEY IT Program. refs Copyright

Monitoring the vibrations of a gas turbine during its development tests requires manual inspection and interpretation of thousands of diagrams displaying measurements made by hundreds of strain gauges and other transducers. This paper describes a prototype knowledge-based computer system to assist in this task. The features on each diagram are located by image processing methods and interpreted by stored knowledge which represents the experience of vibration engineers. The objective of the system is to distinguish the relatively few diagrams which have unusual features from the majority which have only expected features, leaving the interpretation of the unusual diagrams to real experts.

The paper gives an overall description of the problem of vibration in gas turbines and some details of the image processing and knowledge processing methods used, and shows some examples of typical diagrams handled by the system. Author

A92-40606

A METHOD FOR ESTIMATING THE EFFICIENCY OF GAS TURBINE BLADE COOLING SYSTEMS [METOD OTSENKI EFFEKTIVNOSTI SISTEMY OKHLAZHDENIYA LOPATOK GAZOVYKH TURBIN]

M. N. GALKIN, K. A. MALINOVSKII, I. V. SHEVCHENKO, and M. S. CHERNYI Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1991, p. 27-30. In Russian. refs

Copyright

A new expression is proposed for the efficiency of gas turbine blade cooling. The expression has the form of a function characterizing the work required for pushing the cooling air through the internal cavity of a hollow blade. Such a generalized expression for the blade cooling efficiency is convenient for comparing results obtained for different air flow rates and pressure gradients and makes it possible to use experimental data available from different sources. V.L.

A92-40607

PLOTTING THE UNIVERSAL CHARACTERISTIC OF A COMPRESSOR IN LOW-RPM AND AUTOROTATION REGIMES [POSTROENIE UNIVERSAL'NOI KHARAKTERISTIKI KOMPRESSORA V OBLASTI MALYKH REZHIMOV I NA REZHIMAKH AVTOROTATSII]

V. I. DAINEKO Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1991, p. 30-34. In Russian. refs

Copyright

The existing methods for plotting the universal characteristic of a compressor at low rpm are presented and analyzed. A more general expression is then proposed which makes it possible to plot the universal characteristic not only at low rpm but also for autorotation regimes. The validity of the method is supported by experimental data. V.L.

A92-40608

A MODEL OF THE OPERATION OF THE PULSEJET ENGINE AND A STUDY OF ITS CHARACTERISTICS [MODEL' RABOCHEGO PROTSESSA I ISSLEDOVANIE KHARAKTERISTIK PUL'SIRIUSHCHEGO VRD]

P. P. KOSTENKO, D. A. MUNSHTUKOV, V. L. SIMBIRSKII, and K. V. BELIAKOV Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1991, p. 34-38. In Russian. refs

Copyright

A mathematical model describing the operation of the pulsejet engine is presented. The performance characteristics of the pulsejet engine are analyzed using the method of flow singularities expressed in terms of mass, impulse, and energy sources (sinks). The dependence of the pulsejet parameters on the flow path geometry and fuel combustion characteristics is discussed. V.L.

A92-40609

HEAT TRANSFER ON A CYLINDRICAL SURFACE IN THE CAVITIES OF GAS TURBINE ENGINE ROTORS [TEPLOOTDACHA NA TSILINDRICHESKOI POVERKHNOSTI V POLOSTIAKH ROTOROV GAZOTURBINNYKH DVIGATELEI]

N. N. SALOV Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1991, p. 43-48. In Russian. refs

Copyright

Experimental data on heat transfer on a cylindrical surface inside rotating annular cavities are presented for different coolant flow patterns. The results of the experiments are generalized in the context of similarity theory. The cooling schemes considered are compared in terms of cooling efficiency. V.L.

A92-40610

LOW-FREQUENCY VIBRATIONS OF THE SHUTTERS OF THE VARIABLE LAVAL NOZZLE OF GAS TURBINE ENGINES [NIZKOCHESTOTNYE KOLEBANIYA STVOROK REGULIRUEMOGO SOPLA LAVALIA GTD]

IU. I. TSYBIZOV Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1991, p. 48-52. In Russian. refs

Copyright

The factors responsible to the low-frequency vibrations of the shutters of a variable Laval nozzle are identified, and the mechanisms of this phenomenon are examined. Expressions for calculating the shutter vibrations are presented. It is shown that the low-frequency vibrations can be significantly reduced by profiling the subsonic section of the nozzle. V.L.

A92-40611

A CRITERION FOR ESTIMATING THE ECONOMIC AND OPERATIONAL EFFICIENCY OF THE POWER DISTRIBUTION SYSTEMS OF COMMERCIAL AIRCRAFT [KRITERII OTSENKI EKONOMICHESKOI I EKSPLOATATSIONNOI EFFEKTIVNOSTI SISTEM RASPREDELENIYA ELEKTROENERGII VOZDUSHNYKH SUDOV GRAZHDANSKOI AVIATSII]

V. I. KRIVENTSEV and V. V. DROZDOV Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1991, p. 62-65. In Russian. refs

Copyright

A criterion for evaluating the cost effectiveness of power distribution systems is proposed which includes the principal technical, economical, and operational characteristics, such as reliability and cost of the electric network, the cost of maintenance and labor requirements, and cable maintenance costs. The criterion has been used in the computer optimization of the power distribution systems of long-range commercial aircraft. It has been demonstrated that the use of this criterion makes it possible to significantly reduce the cost of the system operation in comparison with the structural mass criterion. V.L.

A92-40615

LOCAL HEAT TRANSFER IN THE PERFORATION CHANNELS OF TURBINE NOZZLE VANES [LOKAL'NAIA TEPLOOTDACHA V KANALAKH PERFORATSII SOPLOVYKH LOPATOK TURBIN]

K. M. ISKAKOV and O. E. SOLODOVNIKOV Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1991, p. 75-77. In Russian. refs

Copyright

The use of the existing criterial expressions for the mean heat transfer in blade perforation channels for determining the temperature field of even a relatively thin perforated blade wall may lead to an error since no allowance is made for the distribution of the heat transfer coefficient over the channel length. Here, this error is estimated by conducting a numerical experiment for a cylindrical element with a perforation channel. It is found that the failure to account for the change of the heat transfer coefficient along the channel length produces an error of 5-25 K, depending on the relative channel length. Local heat transfer in blade channels is investigated, and the results are generalized in the form of a similarity equation. V.L.

A92-40621

A METHOD FOR ESTIMATING THE TECHNOLOGICAL AND ECONOMIC EFFICIENCY OF MEASURES ENHANCING THE RELIABILITY OF AVIATION GAS TURBINE ENGINES [METODIKA OTSENKI TEKHNIKO-EKONOMICHESKOI EFFEKTIVNOSTI MEROPRIIATII, POVYSHAIUSHCHIKH NADEZHNOST' AVIATSIONNYKH GTD V EKSPLOATATSII]

A. I. EVDOKIMOV and A. I. RYDAEV Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1991, p. 95-99. In Russian. refs

Copyright

A mathematical model is presented which describes the effect of various steps aimed at reducing the premature engine dismantling on the integral reliability characteristics of gas turbine engines. The reliability-enhancing measures are then analyzed from

the standpoint of their technological and economic efficiency. Some specific examples are discussed. V.L.

A92-40943

PUSHER TURBOPROP INSTALLATION TECHNOLOGY FOR THE EMBRAER CBA-123 VECTOR

R. S. REULAND (Allied-Signal Aerospace Co., Garrett Engine Div., Phoenix, AZ) SAE, General, Corporate and Regional Aviation Meeting and Exposition, Wichita, KS, Apr. 9-11, 1991. 8 p. (SAE PAPER 911030) Copyright

The installation development of the TPF 351-20 thermodynamic shp turboprop to power the 19-passenger CBA-123 commuter aircraft is described, and the engineering studies to meet the basic design goals of the aircraft are discussed. The turboprop incorporates full-authority digital electronic control (FADEC) and provides advanced component technologies to yield optimum powerplant efficiencies. Particular attention is given to maintainability features including individual mechanical component accessibility and FADEC diagnostic capabilities. O.G.

N92-24336# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

BOUNDARY LAYERS IN TURBOMACHINES

1991 496 p Lecture series held in Rhode-Saint-Genese, Belgium, 2-6 Sep. 1991 (VKI-LS-1991-06; ISSN-0377-8312; ETN-92-91262) Avail: NTIS HC/MF A21

An overview of the latest progress made in the understanding of turbomachinery flows is presented. Special emphasis is put on the phenomenon of boundary layer transition. Both experimental and numerical aspects of the problem are considered. A basic description of the fundamental aspects of boundary layers and transition as applied to turbomachinery flows is given. The experimental identification of different flow phenomena within boundary layers and the correct design and exploitation of such experiments are reported. The development of boundary layers along concave surfaces is studied. The modeling of the transition zone in a boundary layer is presented. The unsteady aspects of boundary layers and transition are considered. The present status of numerical modeling of turbomachinery boundary layer flows is dealt with.

ESA

N92-24337# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Mechanical Engineering.

FUNDAMENTAL ASPECTS OF BOUNDARY LAYERS AND TRANSITION IN TURBOMACHINES

ROBERT E. MAYLE In VKI, Boundary Layers in Turbomachines 62 p 1991 Avail: NTIS HC/MF A21

Boundary layer equations for laminar flow, turbulent flow and intermittent flow are presented. The transition modes in gas turbines are considered. The transition theory is reviewed. Transition experiments are described. The periodic unsteady transition phenomenon, and transition in through flow components are reported, with special emphasis on transition phenomena in compressors, in combustors, and low pressure and high pressure turbines. General flow considerations are given. ESA

N92-24338# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).

INVESTIGATIONS OF BLADE ROW INTERACTION AND BOUNDARY LAYER TRANSITION PHENOMENA IN A MULTISTAGE AERO ENGINE LOW-PRESSURE TURBINE BY MEASUREMENTS WITH HOT-FILM PROBES AND SURFACE-MOUNTED HOT-FILM GAUGES

TH. SCHROEDER In VKI, Boundary Layers in Turbomachines 50 p 1991 Avail: NTIS HC/MF A21

Hot film probe measurements were made downstream of every rotor blade row of a five stage low pressure turbine, in order to enhance the understanding of unsteady flow phenomena in multistage low pressure turbines. Hot film gages glued in the vane

surfaces were used to locate the separation. New measuring techniques are presented. Unsteady signal traces were recorded, using fast digital data acquisition systems, and special evaluation procedures. Results obtained in hot film probe measurements and in surface hot film gauge measurements. It is shown that evaluation of these measurements is to be made with the aid of the ensemble averaging technique. ESA

N92-24340# Cambridge Univ. (England). Whittle Lab.

ASPECTS OF UNSTEADY BLADE-SURFACE BOUNDARY LAYERS AND TRANSITION IN AXIAL TURBOMACHINES

H. P. HODSON In VKI, Boundary Layers in Turbomachines 105 p 1991

Avail: NTIS HC/MF A21

The importance of unsteady flows in turbomachines is examined in the context of blade surface boundary layer development. The effect of rotor stator interactions on the development of blade surface boundary layers is considered. The effects of unsteady flow on the development of blade surface boundary layers are considered in the context of single stage flows. The existence of disturbed laminar, transitional and turbulent flow on a flat plate, compressor and turbine blades is demonstrated. A simple model of unsteady transition is described. More complex models based on the concepts of intermittency are examined. It is shown that the problem of predicting the effects of wake induced transition is reduced to one of predicting the start of transition. ESA

N92-24539*# Wisconsin Univ., Madison.

THREE-DIMENSIONAL MODELING OF DIESEL ENGINE INTAKE FLOW, COMBUSTION AND EMISSIONS

R. D. REITZ and C. J. RUTLAND Mar. 1992 70 p (Contract NAG3-1087; DE-AI01-91CE-50306; RTOP 778-34-2A) (NASA-CR-189126; DOE/NASA/1087-1; NAS 1.26:189126) Avail: NTIS HC/MF A04 CSCI 21E

A three-dimensional computer code (KIVA) is being modified to include state-of-the-art submodels for diesel engine flow and combustion: spray atomization, drop breakup/coalescence, multi-component fuel vaporization, spray/wall interaction, ignition and combustion, wall heat transfer, unburned HC and NOx formation, soot and radiation, and the intake flow process. Improved and/or new submodels which were completed are: wall heat transfer with unsteadiness and compressibility, laminar-turbulent characteristic time combustion with unburned HC and Zeldovich NOx, and spray/wall impingement with rebounding and sliding drops. Results to date show that adding the effects of unsteadiness and compressibility improves the accuracy of heat transfer predictions; spray drop rebound can occur from walls at low impingement velocities (e.g., in cold-starting); larger spray drops are formed at the nozzle due to the influence of vaporization on the atomization process; a laminar-and-turbulent characteristic time combustion model has the flexibility to match measured engine combustion data over a wide range of operating conditions; and finally, the characteristic time combustion model can also be extended to allow predictions of ignition. The accuracy of the predictions is being assessed by comparisons with available measurements. Additional supporting experiments are also described briefly. To date, comparisons with measured engine cylinder pressure and heat flux data were made for homogeneous charge, spark-ignited and compression-ignited engines. The model results are in good agreement with the experiments. Author

N92-25164*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

THE FUTURE CHALLENGE FOR AEROPROPULSION

ROBERT ROSEN (National Aeronautics and Space Administration, Washington, DC.) and DAVID N. BOWDITCH 1992 14 p Presented at the Aeroengine 1992, Moscow, USSR, 6-12 Apr. 1992

(Contract RTOP 505-62-00)

(NASA-TM-105613; E-6943; NAS 1.15:105613) Avail: NTIS HC/MF A03

NASA's research in aeropropulsion is focused on improving the efficiency, capability, and environmental compatibility for all

classes of future aircraft. The development of innovative concepts, and theoretical, experimental, and computational tools provide the knowledge base for continued propulsion system advances. Key enabling technologies include advances in internal fluid mechanics, structures, light-weight high-strength composite materials, and advanced sensors and controls. Recent emphasis has been on the development of advanced computational tools in internal fluid mechanics, structural mechanics, reacting flows, and computational chemistry. For subsonic transport applications, very high bypass ratio turbofans with increased engine pressure ratio are being investigated to increase fuel efficiency and reduce airport noise levels. In a joint supersonic cruise propulsion program with industry, the critical environmental concerns of emissions and community noise are being addressed. NASA is also providing key technologies for the National Aerospaceplane, and is studying propulsion systems that provide the capability for aircraft to accelerate to and cruise in the Mach 4-6 speed range. The combination of fundamental, component, and focused technology development underway at NASA will make possible dramatic advances in aeropropulsion efficiency and environmental compatibility for future aeronautical vehicles. Author

N92-25712*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

WORKSHOP ON GRID GENERATION AND RELATED AREAS
Apr. 1992 160 p Workshop held in Cleveland, OH, 14-15 Nov. 1991

(Contract RTOP 505-62-52)

(NASA-CP-10089; E-6823; NAS 1.55:10089) Avail: NTIS HC/MF A08

A collection of papers given at the Workshop on Grid Generation and Related Areas is presented. The purpose of this workshop was to assemble engineers and scientists who are currently working on grid generation for computational fluid dynamics (CFD), surface modeling, and related areas. The objectives were to provide an informal forum on grid generation and related topics, to assess user experience, to identify needs, and to help promote synergy among engineers and scientists working in this area. The workshop consisted of four sessions representative of grid generation and surface modeling research and application within NASA LeRC. Each session contained presentations and an open discussion period.

N92-25716*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

TCGRID: A THREE DIMENSIONAL C-GRID GENERATOR FOR TURBOMACHINERY

RODRICK V. CHIMA In its Workshop on Grid Generation and Related Areas p 39-53 Apr. 1992
Avail: NTIS HC/MF A08

A fast 3-D grid code for turbomachinery was developed. The code, TCGRID (Turbomachinery C-GRID), can generate either C or H type grids for fairly arbitrary axial or radial turbomachinery geometries. The code also has limited blocked grid capability and can generate an axisymmetric H type grid upstream of the blade row or an O type grid within the tip clearance region. Hub and tip geometries are input as a simple list of pairs. All geometric data is handled using parametric splines so that geometries that turn 90 degrees can be handled without difficulty. Blade input is in standard MERIDL or Lewis compressor design code format. TCGRID adds leading and trailing edge circles to MERIDL geometries and intersects the blade with the hub and tip if necessary using a novel intersection algorithm. The procedure used to generate the grid is given. Output is in PLOT3D format, which can also be read by the RVC3D (Rotor Viscous Code 3-D) Navier-Stokes code for turbomachinery. Intermediate 2-D or 3-D grids useful for debug and other purposes can also be output using a convenient output flag. A grid generated figure is given. Author

N92-25717*# Sverdrup Technology, Inc., Cleveland, OH.
AN INTERACTIVE GRID GENERATION TECHNIQUE FOR TURBOMACHINERY Abstract Only

TIM BEACH In NASA. Lewis Research Center, Workshop on Grid Generation and Related Areas p 55-56 Apr. 1992
Avail: NTIS HC/MF A08

A combination algebraic/elliptic technique is presented for the generation of 3-D grids about turbomachinery blade rows for both axial and radial flow machinery. The technique is built around use of an advanced engineering workstation to construct several 2-D grids interactively on predetermined blade-to-blade surfaces. A 3-D grid is generated by interpolating these surface grids onto an axisymmetric grid. On each blade to blade surface, a grid is created using algebraic techniques near the blade to control orthogonality within the boundary layer region and elliptic techniques in the mid-passage to achieve smoothness. The interactive definition of bezier curves as internal boundaries is the key to simple construction. The approach is adapted for use with the average passage solution technique, although this is not a limitation for most other uses. A variety of examples are presented. Author

N92-25718*# Mississippi State Univ., State College. Engineering Research Center.

TIGER: TURBOMACHINERY INTERACTIVE GRID GENERATION

BHARAT K. SONI, MING-HSIN SHIH, and J. MARK JANUS In NASA. Lewis Research Center, Workshop on Grid Generation and Related Areas p 57-63 Apr. 1992
Avail: NTIS HC/MF A08

A three dimensional, interactive grid generation code, TIGER, is being developed for analysis of flows around ducted or unducted propellers. TIGER is a customized grid generator that combines new technology with methods from general grid generation codes. The code generates multiple block, structured grids around multiple blade rows with a hub and shroud for either C grid or H grid topologies. The code is intended for use with a Euler/Navier-Stokes solver also being developed, but is general enough for use with other flow solvers. TIGER features a silicon graphics interactive graphics environment that displays a pop-up window, graphics window, and text window. The geometry is read as a discrete set of points with options for several industrial standard formats and NASA standard formats. Various splines are available for defining the surface geometries. Grid generation is done either interactively or through a batch mode operation using history files from a previously generated grid. The batch mode operation can be done either with a graphical display of the interactive session or with no graphics so that the code can be run on another computer system. Run time can be significantly reduced by running on a Cray-YMP. Author

N92-25719*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

TIGGERC: TURBOMACHINERY INTERACTIVE GRID GENERATOR ENERGY DISTRIBUTOR AND RESTART CODE

DAVID P. MILLER In its Workshop on Grid Generation and Related Areas p 65-73 Apr. 1992
Avail: NTIS HC/MF A08

A two dimensional multi-block grid generator was developed for a new design and analysis system for studying multi-blade row turbomachinery problems with an axisymmetric viscous/inviscid 'average passage' through flow code. TIGGERC is a mouse driven, fully interactive grid generation program which can be used to modify boundary coordinates and grid packing. TIGGERC generates grids using a hyperbolic tangent or algebraic distribution of grid points on the block boundaries and the interior points of each block grid are distributed using a transfinite interpolation approach. TIGGERC generates a blocked axisymmetric H grid, C grid, I grid, or O grid for studying turbomachinery flow problems. TIGGERC was developed for operation on small high speed graphic workstations. Author

N92-25720*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MULTIBLOCK GRID GENERATION FOR JET ENGINE CONFIGURATIONS

MARK E. M. STEWART *In its Workshop on Grid Generation and Related Areas* p 79-84 Apr. 1992
 Avail: NTIS HC/MF A08

The goal was to create methods for generating grids with minimal human intervention that are applicable to a wide range of problems and compatible with existing numerical methods and with existing and proposed computers. The following topics that are related to multiblock grid generation are briefly covered in viewgraph form: finding a domain decomposition, dimensioning grids, grid smoothing, manipulating grids and decompositions, and some specializations for jet engine configurations. Author

N92-25808* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

COMPUTATIONAL FLUID DYNAMICS

Feb. 1992 219 p Conference held at Moffett Field, CA, 12-14 Mar. 1991; sponsored by NASA. Ames Research Center Original contains color illustrations
 (Contract RTOP 505-62-52)
 (NASA-CP-10078; E-6374; NAS 1.55:10078) Avail: NTIS HC/MF A10; 11 functional color pages

This collection of papers was presented at the Computational Fluid Dynamics (CFD) Conference held at Ames Research Center in California on March 12 through 14, 1991. It is an overview of CFD activities at NASA Lewis Research Center. The main thrust of computational work at Lewis is aimed at propulsion systems. Specific issues related to propulsion CFD and associated modeling will also be presented. Examples of results obtained with the most recent algorithm development will also be presented.

N92-25933* Pratt and Whitney Aircraft, East Hartford, CT.

COMPUTATIONAL STRUCTURAL ANALYSIS AND ADVANCED COMMERCIAL ENGINES

R. B. WILSON *In NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems* p 473-490 May 1992
 Avail: NTIS HC/MF A22

The history of computational structural analysis is reviewed and anticipated requirements for the design, development, and support of advanced commercial engines is discussed. The present commercial engine environment is comprised primarily of turbofan engines containing monolithic titanium and nickel alloys. Future commercial engines will make extensive use of composite materials to meet demanding high temperature requirement and aggressive weight goals, since only modestly higher capabilities can be anticipated in monolithic materials. Engine configurations will include ducted and/or unducted propfans and super turbojet in addition to turbofans. Author

N92-25934* Wright Lab., Wright-Patterson AFB, OH.

MILITARY ENGINE COMPUTATIONAL STRUCTURES TECHNOLOGY

DANIEL E. THOMSON *In NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems* p 491-506 May 1992
 Avail: NTIS HC/MF A22

Integrated High Performance Turbine Engine Technology Initiative (IHPTET) goals require a strong analytical base. Effective analysis of composite materials is critical to life analysis and structural optimization. Accurate life prediction for all material systems is critical. User friendly systems are also desirable. Post processing of results is very important. The IHPTET goal is to double turbine engine propulsion capability by the year 2003. Fifty percent of the goal will come from advanced materials and structures, the other 50 percent will come from increasing performance. Computer programs are listed. Author

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

A92-36990

AIRCRAFT CONTROL FOR TAKE-OFF IN WINDSHEAR

VEIJO KAITALA (Helsinki University of Technology, Espoo, Finland), GEORGE LEITMANN, and SANDEEP PANDEY (California, University, Berkeley) Dynamics and Control (ISSN 0925-4668), vol. 1, no. 3, Sept. 1991, p. 239-252. Research supported by Academy of Finland, Finnair, and USAF. refs (Contract NSF ECS-86-02524)
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The controlled take-off of an aircraft flying through an unavoidable windshear is studied. The purpose of the guidance is to guarantee aircraft take-off without crash; no other performance criteria are applied. The proposed aircraft take-off control scheme consists of a memoryless state-feedback control strategy for a class of continuous-time aircraft models including unpredictable but bounded windshear. The design of the take-off control scheme is carried out by applying a theory of deterministic control of uncertain systems. The time or the place of encountering a windshear is not known but, according to the basic assumption, the upper bound of the uncertainty - here the maximum rate of the change of the wind velocity - is assumed to be known. Such knowledge allows one to design a deterministic controller to stabilize the relative path inclination of the aircraft. Author

A92-37077

MAXIMUM-MISS AIRCRAFT COLLISION AVOIDANCE

A. W. MERZ (Lockheed Missiles and Space Co., Inc., Palo Alto, CA) Dynamics and Control (ISSN 0925-4668), vol. 1, no. 1, March 1991, p. 25-34. refs
 Copyright

Aircraft densities in terminal areas increase each year, and the risk of collision grows proportionally. The maintenance of clearance between aircraft in this environment sometimes calls for evasive maneuvers, which depend on the relative position and relative velocity of two aircraft. In this study, small-amplitude maneuvers are found for either or both aircraft in near-miss configurations. Using practical low-order dynamics, individual maneuvers are found that maximize the miss distance. These optimal maneuvers combine longitudinal (speed) and normal (lift) accelerations. The signs of the accelerations of both aircraft depend on their magnitudes. An evasive climb maneuver, for example, becomes a dive maneuver if the acceleration amplitude exceeds a certain value. The maximum-miss maneuvers appear to have practical potential, because they can be determined on-line from estimated position data for both aircraft, without consideration of detailed inertial and aerodynamic properties of the aircraft. Author

A92-37394

COMPARISON OF TWO FLUTTER ANALYSIS METHODS FOR ELASTIC AIRCRAFT

LIFA YANG and QIANGANG LIU (Northwestern Polytechnical University, Xian, People's Republic of China) Northwestern Polytechnical University, Journal (ISSN 1000-2758), vol. 10, no. 2, April 1992, p. 245-251. In Chinese. refs

A comparison of an analytical method and a graphical method of flutter analysis of elastic aircraft is presented. The graphical method is used to determine the degree of approximation of the analytical method for the first five modes of a single wing of a supersonic aircraft. The difference between the solutions given by these methods increases with increasing flight speed. For the latter, the difference is somewhat greater at medium flight speed than at low or high flight speed. Flutter speeds obtained for three different Roger approximations (three-fraction, four-fraction, and

five-fraction) are almost the same or greater than that given by the graphical method by less than 10 m/s. P.D.

A92-39893
ROBUST WIND SHEAR STOCHASTIC
CONTROLLER-ESTIMATOR

R. K. PRASANTH, J. E. BAILEY, and K. KRISHNAKUMAR (Alabama, University, Tuscaloosa) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 679-686. Previously cited in issue 21, p. 3317, Accession no. A90-47737. refs
 Copyright

A92-39894
INVERSE AND OPTIMAL CONTROL FOR DESIRED OUTPUTS
 ETSUROH SENTOH and ARTHUR E. BRYSON (Stanford University, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 687-691. Previously cited in issue 21, p. 3317, Accession no. A90-47733. refs
 Copyright

A92-39900
CONTROL SYSTEM OPTIMIZATION USING GENETIC
ALGORITHMS
 K. KRISHNAKUMAR (Alabama, University, Tuscaloosa) and DAVID E. GOLDBERG (Illinois, University, Urbana) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 735-740. Previously cited in issue 21, p. 3317, Accession no. A90-47736. refs
 (Contract NSF CTS-84-51610)
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A92-39902
APPLICATION OF LINEARIZATION ANALYSIS TO AIRCRAFT
DYNAMICS
 B. WIGDOROWITZ (Witwatersrand, University, Johannesburg, Republic of South Africa) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 746-750. refs
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A method for determining when a linear model is an acceptable qualitative approximation capable of predicting the dynamic behavior of a nonlinear model is proposed. Relevant results from the qualitative theory of dynamic systems are reviewed. The method, which is intended for use in linear controller design, for reducing the number of nonlinear simulations required to validate controller designs, and in determining the validity of the simulation model in relation to the physical plant, is illustrated by applying it to an F4-J aircraft model. The method successfully determines when linearization is an acceptable qualitative approximation to the dynamic behavior of the nonlinear dynamic mode. Author

A92-39903* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CONTROL AND DISPLAY COMBINATIONS FOR BLIND
VERTICAL LANDINGS
 J. A. SCHROEDER and V. K. MERRICK (NASA, Ames Research Center, Moffett Field, CA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 751-760. Previously cited in issue 21, p. 3317, Accession no. A90-47764. refs
 Copyright

A92-39904
NONLINEAR CONTROL LAW WITH APPLICATION TO HIGH
ANGLE-OF-ATTACK FLIGHT
 DANIEL J. BUGAJSKI and DALE F. ENNS (Honeywell Systems and Research Center, Minneapolis, MN) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 761-767. Previously cited in issue 21, p. 3315, Accession no. A90-47662. refs
 Copyright

A92-39905* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANALYZING THE FLARED LANDING TASK WITH PITCH-RATE
FLIGHT CONTROL SYSTEMS
 RONALD A. HESS and MARDUKE YOUSEFPOR (California, University, Davis) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 768-774. Previously cited in issue 21, p. 3317, Accession no. A90-47732. refs
 (Contract NAG2-490)
 Copyright

A92-39908
DESIGN OF LOW-SENSITIVITY MODALIZED OBSERVERS
USING LEFT EIGENSTRUCTURE ASSIGNMENT
 S. P. BURROWS and R. J. PATTON (York, University, England) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 779-782. refs
 Copyright

A multiple objective optimization technique is applied to the design of modalized observers. The modalized observer was introduced by Andry et al. (1984) and involves the choice of closed-loop observer left eigenvectors so that the effect of a known mismatch of initial conditions between the observer and plant is minimized. Such mismatches occur, for example, in flight control problems when the aircraft (in a straight and level flight condition) is subject to a gust disturbance that introduces nonzero values to the angle-of-attack and/or sideslip variables. The multiple objective approach involves the optimization of a multicriterion cost function that takes account of both eigenvalue sensitivity and of estimator error caused by an initial condition mismatch. This approach involves the selection of a fixed set of closed-loop observer eigenvalues. The corresponding assignable eigenvector subspaces are then calculated. A slight modification to this approach is applied here to the problem of aircraft gust alleviation. S.A.V.

A92-39909
PULSE RESPONSE METHOD FOR VIBRATION REDUCTION IN
PERIODIC DYNAMIC SYSTEMS
 CARL R. KNOSPE and JOHN K. HAVILAND (Virginia, University, Charlottesville) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 782-785. Research supported by U.S. Army. refs
 Copyright

The application of the pulse response method is described for the active alleviation of vibrations in periodic systems, with attention focused on helicopter vibrations. Adaptive vibration reduction is achieved here through a cautious controller in the discrete-time domain using a pulse response formulation, as opposed to a frequency domain formulation. Since the acceleration measurements are not prefiltered to blade passing frequency before the regulator estimates the parameters of the linear model relating vibration and control, the resulting algorithm reduces vibrations at all harmonics (within Nyquist limitations) simultaneously. S.A.V.

A92-39910
ROBUST FLIGHT CONTROL SYSTEM DESIGN WITH
MULTIPLE MODEL APPROACH
 YOSHIKAZU MIYAZAWA (National Aerospace Laboratory, Chofu, Japan) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 15, no. 3, May-June 1992, p. 785-788. Previously cited in issue 21, p. 3316, Accession no. A90-47666. refs
 Copyright

A92-39984 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CONTROLS FOR AGILITY RESEARCH IN THE NASA
HIGH-ALPHA TECHNOLOGY PROGRAM
 JOHN V. FORSTER, W. T. BUNDICK (NASA, Langley Research Center, Hampton, VA), and JOSEPH W. PAHLE (NASA, Flight Research Center, Edwards, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991.

20 p. refs

(SAE PAPER 912148) Copyright

The research process being used to develop control law design methodologies and guidelines in the NASA High-Alpha Technology Program are discussed. This step-by-step process consists of four basic elements: (1) control law architecture definition and linear synthesis, (2) nonlinear batch simulation, (3) piloted simulation evaluation, and (4) flight test validation. This paper discusses the research tools being used in this effort and provides a status report on design methodologies and guidelines being developed for each of these elements. C.D.

A92-39985

VELOCITY DEPENDENCE OF HIGH ANGLE OF ATTACK LONGITUDINAL FLYING QUALITIES CRITERIA

DAVID J. WILSON, NEIL S. HALL, and DAVID R. RILEY (McDonnell Aircraft Co., Saint Louis, MO) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991.

12 p. refs

(SAE PAPER 912149) Copyright

Piloted simulations were conducted to investigate flying qualities requirements for longitudinal maneuvering at 30 deg angle of attack. Pilot evaluations of various longitudinal dynamics were gathered using acquisition and tracking tasks representative of future fighter air combat maneuvering. Pilot comments and Cooper-Harper Ratings were used to define desired regions of aircraft dynamics. These criteria were then compared to previously developed 30 deg angle of attack criteria for a lower speed flight condition to determine airspeed effects. The desired region of dynamics was found to depend on equivalent airspeed. This dependency can be used to help design control law gain schedules which provide good high angle of attack flying qualities over a wide speed range. Author

A92-40039

RAE BEDFORD VAAC RESEARCH PROJECT

B. SINGER (Defence Research Agency, Bedford, England) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 190-209. refs Copyright

The VSTOL aircraft advanced flight control (VAAC) project of research into advanced short-takeoff/vertical-landing (ASTOVL) flight control is presented. This project is focused around the VAAC Harrier which is configured as a flexible inflight VSTOL research simulator for design of control strategies to ensure that the pilot can utilize the aircraft's complete performance potential safely and with maximum operational effectiveness. Consideration is given to ASTOVL concepts, VAAC aims and objectives, a description of the VAAC Harrier XW 175 test vehicle, and the VAAC digital Harrier clearance program. R.E.P.

A92-40395

1991-92 AHS TECHNICAL COMMITTEE HIGHLIGHTS - HANDLING QUALITIES

STEVEN I. GLUSMAN (Boeing Defense and Space Group, Helicopters Div., Philadelphia, PA) Vertiflite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 86-89.

Copyright

Progress made in 1991-92 in predicting and improving the overall handling characteristics of rotorcraft is reviewed. The areas considered include specifications and requirements, mathematical modeling, design activities, and flight testing. C.D.

N92-25401# National Aerospace Lab., Tokyo (Japan). Advanced Aircraft Research Group.

VIBRATION TESTS AND STRUCTURAL MODELING OF AN AIRCRAFT MODEL FOR ACTIVE CONTROL TECHNOLOGY EXPERIMENTS [ACT JIKKEN YO ZENKI DANSEI MOKEI NO SHINDO SHIKEN TO KOZO MODERU KA]

KENJI FUJII, TETSUHIKO UEDA, and YASUKATSU ANDO Aug. 1990 23 p In JAPANESE

(NAL-TM-626; ISSN-0452-2982; JTN-92-80313) Avail: NTIS HC/MF A03

At the National Aerospace Laboratory (NAL), as a part of the research into an ACT (Active Control Technology) for an aerodynamic elastic system, gust load alleviation tests using aircraft elasticity models were performed in a large scale wind tunnel. This report describes the vibration tests of an aircraft elasticity model built for the ACT experiments. The model's main wing was constructed with elastic characteristics that are similar to the actual aircraft. The structural characteristics of the whole model, including the elastic deformation of the main wing, was studied using a mathematical model. The vibration tests were performed to study the structural dynamic characteristics of the model. The mathematical model for the elastic body was constructed using a finite element method based on test results. The control pattern was designed based on the intrinsic vibration frequencies and elastic deformation. Author (NASDA)

N92-25555 Arizona Univ., Tucson.

PREDICTION AND ANALYSIS OF WING FLUTTER AT TRANSONIC SPEEDS Ph.D. Thesis

TENG-HUA SHIEH 1991 181 p

Avail: Univ. Microfilms Order No. DA9210300

This dissertation deals with the instability known as flutter, of the lifting and control surfaces of aircraft of advanced design at high altitudes and speeds. A simple model is used to represent the aerodynamics for flutter analysis of a two degree of freedom airfoil system. Flutter solutions of this airfoil system are shown to be algebraically homomorphic in that solutions about different elastic axes can be found by mapping them to those about the mid-chord. Algebraic expressions for the flutter speed and frequency are thus obtained. For prediction of flutter of a wing at transonic speeds, an accurate and efficient computer code is developed. The unique features of this code are the capability of accepting a steady mean flow regardless of its origin, a time dependent perturbation boundary condition for describing wing deformations on the wing surface, and a locally applied three dimensional far field boundary condition for minimizing wave reflections from numerical boundaries. Results for various test cases obtained using this code show good agreement with the experiments and other theories. Dissert. Abstr.

N92-25599# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung.

DEVELOPMENT OF FLIGHT TESTING OF A FAULT TOLERANT FLY-BY-LIGHT YAW CONTROL SYSTEM [ENTWICKLUNG UND FLUGPROBUNG EINES FEHLERTOLERANTEN FLY-BY-LIGHT GIERREGELUNGSSYSTEMS]

G. MANSFELD, K. BENDER, and J. TERSTEEGEN In its Flight Test of Avionic and Air-Traffic Control Systems p 154-176 Jul. 1991 In GERMAN

Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

A yaw control system based on optical signal transmission (Fly-By-Light (FBL)) was developed and tested in flight with a B0-105-S3 in order to evaluate the performance and efficiency of new technologies such as FBL, smart actuator, and redundancy management of multiprocessor systems. The systems concept is outlined. The yaw control system has a high dynamic range, complete actuator authority, and a minimal number of sensors. This yaw control system facilitates the task of the pilot, improves the flight path control, and makes the control more quiet. However, the system requires a high actuator authority and error tolerance, that is, a redundant control system with high disturbance resistance. ESA

N92-25607*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

MULTIFUNCTION TESTS OF A FREQUENCY DOMAIN BASED FLUTTER SUPPRESSION SYSTEM

DAVID M. CHRISTHILF (Lockheed Engineering and Sciences Co.,

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Hampton, VA.) and WILLIAM M. ADAMS, JR. May 1992 12 p
Presented at the Dynamics Specialists Conference, Dallas, TX,
16-17 Apr. 1992
(Contract RTOP 505-64-20-01)
(NASA-TM-107615; NAS 1.15:107615; AIAA PAPER 92-2096)
Avail: NTIS HC/MF A03

The process is described of analysis, design, digital implementation, and subsonic testing of an active control flutter suppression system for a full span, free-to-roll wind tunnel model of an advanced fighter concept. The design technique uses a frequency domain representation of the plant and used optimization techniques to generate a robust multi input/multi output controller. During testing in a fixed-in-roll configuration, simultaneous suppression of both symmetric and antisymmetric flutter was successfully shown. For a free-to-roll configuration, symmetric flutter was suppressed to the limit of the tunnel test envelope. During aggressive rolling maneuvers above the open-loop flutter boundary, simultaneous flutter suppression and maneuver load control were demonstrated. Finally, the flutter damping controller was reoptimized overnight during the test using combined experimental and analytical frequency domain data, resulting in improved stability robustness. Author

N92-25648* Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.

APPLICATION OF NONLINEAR FEEDBACK CONTROL THEORY TO SUPERMANEUVERABLE AIRCRAFT Final Report, 21 Sep. 1988 - 21 Dec. 1991

WILLIAM L. GARRARD and DALE F. ENNS 21 Dec. 1991 10 p

(Contract NAG1-821)
(NASA-CR-190336; NAS 1.26:190336) Avail: NTIS HC/MF A02

Controlled flight at extremely high angles of attack, far exceeding the stall angle, and/or at high angular rates is sometimes referred to as supermaneuvering flight. The objective was to examine methods for design of control laws for aircraft performing supermaneuvers. Since the equations which govern the motion of aircraft during supermaneuvers are nonlinear, this study concentrated on nonlinear control law design procedures. The two nonlinear techniques considered were Nonlinear Quadratic Regulator (NLQR) theory and nonlinear dynamic inversion. A conventional gain scheduled proportional plus integral (P + I) controller was also developed to serve as a baseline design typical of current control laws used in aircraft. A mathematical model of a generic supermaneuverable aircraft was developed from data obtained from the literature. A detailed computer simulation of the aircraft was also developed. This simulation allowed the flying of proposed supermaneuvers and was used to evaluate the performance of the control law designs and to generate linearized models of the aircraft at different flight conditions. Author

N92-25734* National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.

A PRELIMINARY LOOK AT AN OPTIMAL MULTIVARIABLE DESIGN FOR PROPULSION-ONLY FLIGHT CONTROL OF JET-TRANSPORT AIRCRAFT Final Report

CHRISTOPHER P. AZZANO (San Jose State Univ., CA.) Apr. 1992 55 p

(Contract RTOP 533-02-21)
(NASA-CR-186014; H-1729; NAS 1.26:186014) Avail: NTIS HC/MF A04

Control of a large jet transport aircraft without the use of conventional control surfaces was studied. Engine commands were used to attempt to recreate the forces and moments typically provided by the elevator, ailerons, and rudder. Necessary conditions for aircraft controllability were developed pertaining to aircraft configuration such as the number of engines and engine placement. An optimal linear quadratic regulator controller was developed for the Boeing 707-720, in particular, for regulation of its natural dynamic modes. The design used a method of assigning relative weights to the natural modes, i.e., phugoid and dutch roll, for a more intuitive selection of the cost function. A prototype pilot command interface was then integrated into the loop based on

pseudorate command of both pitch and roll. Closed loop dynamics were evaluated first with a batch linear simulation and then with a real time high fidelity piloted simulation. The NASA research pilots assisted in evaluation of closed loop handling qualities for typical cruise and landing tasks. Recommendations for improvement on this preliminary study of optimal propulsion only flight control are provided. Author

N92-25982* Systems Technology, Inc., Hawthorne, CA.

ASSESSMENT OF FLYING-QUALITY CRITERIA FOR AIR-BREATHING AEROSPACECRAFT

DUANE T. MCRUER, THOMAS T. MYERS, ROGER H. HOH, IRVING L. ASHKENAS, and DONALD E. JOHNSTON
Washington NASA Jun. 1992 80 p Prepared for PRC Krypton, Inc., Edwards, CA

(Contract NAS2-12722; ATD-88-STI-0221; RTOP 505-64-40)
(NASA-CR-4442; H-1758; NAS 1.26:4442; STI-TR-2361-2) Avail: NTIS HC/MF A05

A study of flying quality requirements for air breathing aerospacecraft gives special emphasis to the unusual operational requirements and characteristics of these aircraft, including operation at hypersonic speed. The report considers distinguishing characteristics of these vehicles, including dynamic deficiencies and their implications for control. Particular emphasis is given to the interaction of the airframe and propulsion system, and the requirements for dynamic systems integration. Past operational missions are reviewed to define tasks and maneuvers to be considered for this class of aircraft. Areas of special concern with respect to vehicle dynamics and control are identified. Experience with the space shuttle orbiter is reviewed with respect to flight control system mechanization and flight experience in approach and landing flying qualities for the National Aerospace Plane (NASP). Author

09

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

A92-38129

LASER THERMAL SIMULATION PUTS JET ENGINES TO THE TEST

CONRAD M. BANAS (United Technologies Industrial Lasers, South Windsor, CT) Photonics Spectra (ISSN 0731-1230), vol. 26, no. 4, April 1992, p. 88-90, 92.

Copyright

A laser thermal simulation (LTS) technique is described and used to simulate the cyclic thermal environment experienced by critical jet-engine hot-section parts, yielding the necessary thermal-durability data at a small fraction of the cost and time required for full-scale engine tests. In addition, the new technique makes possible visual observation of the components under thermal loading, providing a direct insight into the component behavior not previously possible. The LTS technique can be used to simulate the operational thermal behavior of components and materials in internal combustion, rocket, and nuclear-powered engines; the identification of material thermal characteristics and mechanical properties at high temperature and thermal flux; the identification of thermal fracture modes; the rapid evaluation of alternative designs; and the cost-effective development of high-temperature components exhibiting extended service life. I.S.

A92-39229* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

LABORATORY TESTING OF A HIGH TRANSMISSION LOSS AIRCRAFT CABIN STRUCTURE

HERBERT L. KUNTZ and ROBERT J. GATINEAU (Lockheed

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Aeronautical Systems Co., Burbank, CA) IN: NOISE-CON 90; Proceedings of the 10th National Conference on Noise Control Engineering, Austin, TX, Oct. 15-17, 1990. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 145-150. refs
(Contract NAS1-18036)

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Laboratory tests have been performed to obtain transmission loss data for an aircraft cabin with Helmholtz resonators installed in the sidewalls, ceiling, and cabin floor, and to determine the effectiveness of resonator installation. It is shown that resonators installed within the sidewalls of an aircraft cabin can significantly reduce SPL values of the fundamental propfan blade passage frequency within the cabin. Resonator performance can be improved by maximizing resonator nozzle to sidewall spacing, and by avoiding noise flanking paths within the sidewall trim design.

R.E.P.

A92-39514

AIRPORT TECHNOLOGY INTERNATIONAL 1992

MAURICE G. HUDSON, ED. London, Sterling Publications, Ltd., 1992, 242 p. No individual items are abstracted in this volume.

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The present yearbook on airport-related technical, commercial, and regulatory developments for 1992 discusses international policies and legislation, airport-policy management in the U.S. and Europe, prospects for Eastern European airport development, the efficient design and operation of intra-transport transit systems, CAD applications in airport civil engineering, the German airport-capacity crisis, and novel methods for passenger handling. Also discussed are airport security operations, maintenance techniques, airfield fire and deicing operations, ATC and navigation, and airport personnel training.

O.C.

A92-39991* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

RUNWAY DRAINAGE CHARACTERISTICS RELATED TO TIRE FRICTION PERFORMANCE

THOMAS J. YAGER (NASA, Langley Research Center, Hampton, VA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 10 p. refs
(SAE PAPER 912156) Copyright

The capability of a runway pavement to rapidly drain water buildup during periods of precipitation is crucial to minimize tire hydroplaning potential and maintain adequate aircraft ground operational safety. Test results from instrumented aircraft, ground friction measuring vehicles, and NASA Langley's Aircraft Landing Dynamics Facility (ALDF) track have been summarized to indicate the adverse effects of pavement wetness conditions on tire friction performance. Water drainage measurements under a range of rainfall rates have been evaluated for several different runway surface treatments including the transversely grooved and longitudinally grinded concrete surfaces at the Space Shuttle Landing Facility (SLF) runway at NASA Kennedy Space Center in Florida. The major parameters influencing drainage rates and extent of flooding/drying conditions are identified. Existing drainage test data are compared to a previously derived empirical relationship and the need for some modification is indicated. The scope of future NASA Langley research directed toward improving empirical relationships to properly define runway drainage capability and consequently, enhance aircraft ground operational safety, is given.

Author

A92-40622

AN AUTOMATED WORKSTATION FOR THE HALF-SCALE TESTING OF THE FLIGHT VEHICLE STABILIZATION CIRCUIT (AVTOMATIZIROVANNOE RABOCHEE MESTO POLUNATURNYKH ISPYTANII KONTURA STABILIZATSII LA)

V. I. KRUGLOV, A. A. LISOV, V. E. SHEVCHENKO, and T. A. CHERNOVA. Aviatsonnaia Tekhnika (ISSN 0579-2975), no. 4, 1991, p. 99-103. In Russian. refs

Copyright

The principles of half-scale modeling, which is commonly used for the testing of the stabilization circuit of flight vehicles, are

briefly examined, and the advantages and disadvantages of this approach are discussed. In particular, it is shown that, in order to increase the reliability of testing, the number of the tested regimes should be increased to 300-400, which can be achieved by using an automated workstation. An implementation of such a workstation is described, with attention given to its hardware and software, principal functions, and accuracy of the results.

V.L.

N92-25090* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

MECHANICAL DESIGN OF A ROTARY BALANCE SYSTEM FOR NASA. LANGLEY RESEARCH CENTER'S VERTICAL SPIN TUNNEL

J. W. ALLRED and V. J. FLECK. In NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium p 349-366 May 1992

Avail: NTIS HC/MF A17 CSCL 14/2

A new lightweight Rotary Balance System is presently being fabricated and installed as part of a major upgrade to the existing 20 Foot Vertical Spin Tunnel. This upgrade to improve model testing productivity of the only free spinning vertical wind tunnel includes a modern fan/drive and tunnel control system, an updated video recording system, and the new rotary balance system. The rotary balance is a mechanical apparatus which enables the measurement of aerodynamic force and moment data under spinning conditions (100 rpm). This data is used in spin analysis and is vital to the implementation of large amplitude maneuvering simulations required for all new high performance aircraft. The new rotary balance system described in this report will permit greater test efficiency and improved data accuracy. Rotary Balance testing with the model enclosed in a tare bag can also be performed to obtain resulting model forces from the spinning operation. The rotary balance system will be stored against the tunnel sidewall during free flight model testing.

Author

N92-25091* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE 12-FOOT PRESSURE WIND TUNNEL RESTORATION PROJECT MODEL SUPPORT SYSTEMS

GLEN E. SASAKI. In NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium p 367-381 May 1992

Avail: NTIS HC/MF A17 CSCL 14/2

The 12 Foot Pressure Wind Tunnel is a variable density, low turbulence wind tunnel that operates at subsonic speeds, and up to six atmospheres total pressure. The restoration of this facility is of critical importance to the future of the U.S. aerospace industry. As part of this project, several state of the art model support systems are furnished to provide an optimal balance between aerodynamic and operational efficiency parameters. Two model support systems, the Rear Strut Model Support, and the High Angle of Attack Model Support are discussed. This paper covers design parameters, constraints, development, description, and component selection.

Author

N92-25162* Eloret Corp., Sunnyvale, CA.

EXPERIMENTAL INVESTIGATION OF NOZZLE/PLUME AERODYNAMICS AT HYPERSONIC SPEEDS Progress

Research Report, 1 Apr. 1991 - 31 Jan. 1992

DAVID W. BOGDANOFF 16 Mar. 1992 16 p

(Contract NCC2-487)

(NASA-CR-190074; NAS 1.26:190074) Avail: NTIS HC/MF A03

An extensive program to improve the operation of the Ames 16 Inch Shock Tunnel was carried out. This included reduction of driver slosh wave amplitudes and detonation risk by the use of premixed He/O₂ gas, longer wait times between the last gas load and driver gas ignition, an improved gas loading sequence, the use of four instead of one ignition wire, and the use of lower ignition wire voltages. Successful operation of the tunnel at pressures of 2000-6000 psi and enthalpies up to 12,000 J/gm was achieved. A new diaphragm breaking technique, self break on the driver combustion pressure rise, was tested and found to produce clean breaks over the full pressure range of the tunnel. Improvements were made to the driver gas loading manifold and

a preliminary design was made of a gas mixing system which mixes all three gases on the fly just before injection into the driver. Other improvements as well as tests are discussed.

Author

N92-25365# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

STUDY OF THE NAL'S 0.1 X 0.1 M MAGNETIC SUSPENSION AND BALANCE SYSTEM [0.1 METORU KAKERU 0.1 METORU JIRYOKU SHIJI SOCHI NO SHISAKU]

HIDEO SAWADA, HIROSHI KANDA, and HISASHI SUENAGA Jun. 1990 20 p In JAPANESE

(NAL-TM-623; ISSN-0452-2982; JTN-92-80311) Avail: NTIS HC/MF A03

For wind tunnel tests where the model is supported inside the measuring unit, the support has to be constructed so that it will not disturb the flow field around the model. A magnetic suspension and balance system for a model was devised, as considerations on the interference from the support was not necessary. The magnetic support does not require any member inside the measuring unit and the air flow behind the model is not disturbed. First, basic structure and a brief history of the magnetic suspension and balance system is described. Then the actual design method of the 0.1 x 0.1 m magnetic suspension and balance system developed at NAL is presented. From test results of this system, the magnetic suspension and balance system circuit, power supply capacity, winding turns of the coil, and model location and inclination measuring sensor proved to be satisfactory. The improvement of measuring accuracy and control ability for the direction of y-axis and psi-axis are needed. Author (NASDA)

N92-25402# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.

THE FIBRE OPTIC THREE DIMENSIONAL LASER TWO FOCUS VELOCIMETER FOR THE LOW-SPEED WINDTUNNEL.

PART 1: TWO-DIMENSIONAL MEASUREMENT EVALUATIONS SHOHEI TAKAGI, KATSUICHI MUROTA, NAOAKI KUWANO, and SHIGEO KAYABA Sep. 1990 33 p In JAPANESE; ENGLISH summary

(NAL-TM-627; ISSN-0452-2982; JTN-92-80314) Avail: NTIS HC/MF A03

A fiber optic three dimensional Laser Two Focus (L2F) Velocimeter was introduced in the Aircraft Aerodynamics Div. in 1988. The former half of the present report describes both an outline and the principle of this system for two dimensional measurements. In the latter half, the L2F Velocimeter is evaluated by using three types of flows, i.e., two dimensional wake, three dimensional boundary layer, and quasi two dimensional free jet with, and occasionally without, seeding particles. Furthermore, several seeding particles such as paraffine vapor, mosquito repellent smoke, and tobacco smoke are used for evaluations. The axial velocity component from the L2F Velocimeter is pointwisely compared with a calibrated velocity. The comparison is extended to the transverse mean velocity component and fluctuating components with hot-wire measurements, in which great care was taken with the linearity and wire inclination. There is no incongruity in comparison except in low turbulence with less than two percent intensity to the local velocity. In summary, features of the fiber optic L2F Velocimeter are its applicability to natural seed, wall proximity, and noncalibration measurements, although it is apriori known that the L2F Velocimeter is not adaptable to both reverse flow and high turbulence measurements.

Author (NASDA)

N92-25449*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ENGINE COMPONENT INSTRUMENTATION DEVELOPMENT FACILITY AT NASA LEWIS RESEARCH CENTER

ROBERT J. BRUCKNER, ALVIN E. BUGGELE, and JAN LEPICOVSKY (Sverdrup Technology, Inc., Brook Park, OH.) 1992 10 p Proposed for presentation at the 17th Aerospace Ground Testing Conference, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA

(Contract RTOP 505-62-84)

(NASA-TM-105644; E-6999; NAS 1.15:105644; AIAA PAPER 92-3995) Avail: NTIS HC/MF A02

The Engine Components Instrumentation Development Facility at NASA Lewis is a unique aeronautics facility dedicated to the development of innovative instrumentation for turbine engine component testing. Containing two separate wind tunnels, the facility is capable of simulating many flow conditions found in most turbine engine components. This facility's broad range of capabilities as well as its versatility provide an excellent location for the development of novel testing techniques. These capabilities thus allow a more efficient use of larger and more complex engine component test facilities. Author

N92-25593# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Flugfuehrung. **GROUND INSTALLATIONS FOR THE PREPARATION AND EVALUATION OF FLIGHT TESTS [BODENEINRICHTUNGEN ZUR VORBEREITUNG UND AUSWERTUNG VON FLUGVERSUCHEN]**

G.-J. BARTH *In its* Flight Test of Avionic and Air-Traffic Control Systems p 49-56 Jul. 1991 In GERMAN

Avail: NTIS HC/MF A12; DLR, Wissenschaftliches Berichtswesen, Postfach 90 60 58, 5000 Cologne 90, Fed. Republic of Germany, HC 75 Deutsche marks

The possibilities of telemetric ground equipment to support flight tests are outlined. The available telemetric equipment can be used centrally for all flight tests, but does not cover the whole domain. Therefore, equipment for special tests is also available. Three groups of telemetric equipment (basic pulse code modulation (PCM) decommutators, decommutators with support, and PC decommutators) are introduced. The telemetric output of measured data in the classical analog way is treated. Calibrated data can be represented in the screen as figures or as bars. Time evolutions can be represented on the screen as well as on a recorder.

ESA

N92-25733# Federal Aviation Administration, Atlantic City, NJ.

EVALUATION OF A TRITIUM RUNWAY LIGHTING SYSTEM

ERIC S. KATZ Apr. 1992 21 p Original contains color illustrations

(DOT/FAA/CT-TN92/15) Avail: NTIS HC/MF A03

A tritium powered runway lighting system was installed and evaluated at the FAA Technical Center. An attempt was made to determine if the tritium runway lighting system would safely support Federal Aviation Regulations (FAR) Part 135 commercial operations, during night time visual flight rules (VFR) conditions at remote airports. Subject pilots having flight experience levels appropriate for pilots conducting FAR Part 135 air taxi operations were afforded the opportunity of flight testing the system. Results of the evaluation indicate that the tritium runway lighting system does not meet all of the minimum criteria necessary for FAA approval and, therefore, would not guarantee an acceptable level of safety. Author

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ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

A92-36952

ACCELERATORS AND DECELERATORS FOR LARGE HYPERSONIC AIRCRAFT

EDWARD LANTZ Journal of Propulsion and Power (ISSN

0748-4658), vol. 8, no. 3, May-June 1992, p. 539, 540. Abridged. Previously cited in issue 17, p. 2655, Accession no. A90-40582. Copyright

A92-36965**SIMILARITY AND SCALE EFFECTS IN SOLID-FUEL RAMJET COMBUSTORS**

RACHEL BEN-AROSH and ALON GANY (Technion - Israel Institute of Technology, Haifa) (International Symposium on Air Breathing Engines, 9th, Athens, Greece, Sept. 3-8, 1989, Proceedings. Volume 1, p. 127-139) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 3, May-June 1992, p. 615-623. Previously cited in issue 02, p. 161, Accession no. A90-12513. refs Copyright

A92-36966**SOLID-FUEL RAMJET FUEL REGRESSION RATE/THRUST MODULATION**

W. H. CAMPBELL, JR., B. N. KO, S. R. LOWE, and D. W. NETZER (U.S. Naval Postgraduate School, Monterey, CA) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 3, May-June 1992, p. 624-629. refs (Contract N60530-86-WR-30021)

An experimental investigation was conducted to determine if inlet air swirl and/or secondary gaseous injection could be used effectively for fuel regression rate control or thrust modulation in a solid-fuel ramjet. Inlet swirl characteristics were measured in nonreacting flows. Tests were conducted at high and low air mass fluxes using three fuel compositions with equivalence ratios between 0.5 and 1.8. Swirl introduced downstream of the air inlet was found to be effective for obtaining limited increases in the fuel regression rate, but the magnitude was highly dependent upon motor geometry. Swirl interactions with the reattaching inlet flow and/or significantly increased near-wall mixing were found to be detrimental to efficient combustion. Energetic gaseous fuels (H_2 , C_2H_4) can be easily injected and efficiently burned under fuel-lean conditions to significantly enhance thrust. Author

A92-36967**WIND TUNNEL STUDY OF AERODYNAMIC CHARACTERISTICS OF BASE COMBUSTION**

ZESHENG DING, SHAOSONG CHEN, YAFEI LIU, RONG LUO, and JINGYUAN LI (East China Institute of Technology, Nanjing, People's Republic of China) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 3, May-June 1992, p. 630-634. refs

Copyright

This paper discusses experimental research on the aerodynamic characteristics of base bleeding with combustion of fuel-rich solid fuel in flows at subsonic, transonic, and supersonic speeds. The effects of ejection parameter, freestream Mach number, geometry parameter of jet hole, rotary speed of model, and combustion temperature at jet hole on the base drag reduction rate for the model are investigated. The results show significant differences of drag reduction characteristics between base combustion of fuel-rich solid fuel and base bleeding of cold or hot gas. Author

A92-37375**THE NATIONAL AEROSPACE PLANE PROGRAM AND THE APL ROLE**

MICHAEL E. WHITE (Johns Hopkins University, Laurel, MD) Johns Hopkins APL Technical Digest (ISSN 0270-5214), vol. 13, no. 1, Jan.-Mar. 1992, p. 218-229. refs

Copyright

This article is an overview of the National Aerospace Plane program and summarizes the Applied Physics Laboratory's contributions to the development of the requisite propulsion and propulsion-related technologies for the development of the airbreathing propulsion system of the vehicles. Author

A92-38213**MATERIALS AND STRUCTURES FOR HERMES**

O. FRANC and J. L. MACRET (Aerospatiale, Saint-Medard-en-

Jalles, France) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 97-109. Previously announced in STAR as N91-23258.

The TPS (Thermal Protection System) for the Hermes Spaceplane, the manufacturing of oxidation resistant Carbon/Carbon (C/C Inox) to be used in the Spaceplane leading edges and nose cap, and nondestructive tests are described. The Hermes programs and configuration and elementary phases of a typical Hermes mission are outlined. The SIMOUN testing device for testing Hermes materials under conditions as close as possible to the reentry conditions by submission to a very hot air flux created by a plasma generator is outlined. The large parts feasibility is concluded to be demonstrated for the Hermes program, first thermomechanical characterization results measured on material and parts reaching the forecast performances. Author

A92-38478*#

National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

SHUTTLE AUTOLAND STATUS SUMMARY

HOWARD G. LAW and LARRY B. MCWHORTER (NASA, Johnson Space Center, Houston, TX) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 19 p. refs

(AIAA PAPER 92-1273) Copyright

The configuration of the Space Shuttle System Automatic Landing Capability (autoland) is presented, and the operational issues in the development of the autoland system are discussed. Special attention is given to the autoland system capability, the system requirements, the guidance trajectory, and the energy control elements. The issues surfaced in the Orbital Flight Test program and the changes made in the autoland system during the 1985 to 1989 period are examined. I.S.

A92-38569*#

National Aeronautics and Space Administration, Washington, DC.

NASP - A STATUS REPORT

JOHN P. THOMAS, JR. and WILLIAM E. POWELL (National Aero-Space Plane Joint Program Office, Wright-Patterson AFB, OH) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 10 p. refs

(AIAA PAPER 92-1417) Copyright

The current status of the NASP program, a joint DoD-NASA effort in advancing the technologies needed for the X-30 research flight vehicle is described. The X-30 single stage to orbit (SSTO) vehicle utilizes an air-breathing primary propulsion system and takes off and lands horizontally on a conventional runway. The technologies under development include high specific strength, high temperature capable materials and structures, ramjet/scramjet propulsion systems, hypersonic aerodynamics and computational fluid dynamics, and cryogenics. A concept for a follow-on NASP-derived operational vehicle and its potential use as a space transportation vehicle are also discussed. O.G.

A92-40033*

National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

PILOTTED SIMULATOR STUDIES OF THE HL-20 LIFTING BODY

ROBERT A. RIVERS, E. B. JACKSON (NASA, Langley Research Center, Hampton, VA), and W. A. RAGSDALE (Unisys Corp., Detroit, MI) IN: 1991 report to the aerospace profession; SETP Symposium, 35th, Beverly Hills, CA, Sept. 26-28, 1991, Proceedings. Lancaster, CA, Society of Experimental Test Pilots, 1991, p. 44-59. refs

Copyright

An overview is presented of the concept, design and development of the NASA Langley Lifting Body, and the flight simulator studies that have been performed. Attention is given to the aerodynamic shape of the HL-20, vehicle and simulator/cockpit description, and evolution of the HL-20 aerodynamic model. The flight simulation studies have demonstrated the HL-20 to be a viable design for accomplishing precise, unpowered, horizontal landings. R.E.P.

N92-24454# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).

FALKE: WINGED RE-ENTRY VEHICLE FLIGHT CONTROL

KLAUS-DIETER RELOTIUS and GASTON NETTER *In* ESA, Spacecraft Guidance, Navigation and Control Systems p 157-162 Dec. 1991 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H. Bremen, Fed. Republic of Germany
Copyright Avail: NTIS HC/MF A99

The analysis and design of GNC (Guidance, Navigation, and Control) algorithms of winged reentry vehicles like Hermes is based on the knowledge of aerodynamic forces and torques. The properties, i.e., the coefficients for the prediction of aerodynamic coefficients and their derivatives, is one of the most difficult tasks. This is due to the complex coupling between kinematics, aerodynamics, and thermodynamics. An understanding of the interdependencies is needed to enable a realistic analysis of flight performance and flight qualities. The prediction of aerodynamic properties is generally obtained by numerical methods. The verification of the results is acquired by wind tunnel tests. In practice the verification turns out to be rather difficult mainly due to the lack of wind tunnel capability to simulate the correct Reynolds and Mach number ranges. An alternative method to obtain aerodynamic coefficients and their derivatives is to perform free flight tests with a scaled down flight model. Predefined maneuvers are executed. The offline analyses of flight data provides the unknown coefficients. To prove the feasibility of this method is one of the main objectives of the FALKE project. ESA

N92-24472# Telespazio, S.p.A., Rome (Italy).

DESCRIPTION AND SIMULATION RESULTS OF THE ITALSAT AOCS ADVANCED FLIGHT SIMULATOR

G. LENZO, R. L. MINCIOTTI, and M. SASSO *In* ESA, Spacecraft Guidance, Navigation and Control Systems p 295-303 Dec. 1991
Copyright Avail: NTIS HC/MF A99

IAFSIM, a real time closed loop simulator of the Italsat Attitude and Orbit Control Subsystem (AOCS), is described. Conventional applications are discussed and the main results of several IAFSIM simulation runs, which cover the main AOCS modes of operation during the various Italsat mission phases, are presented. The simulation results are compared with the actual AOCS test results highlighting the possibility of tuning the IAFSIM to reproduce with high fidelity the real AOCS performances. IAFSIM possible future applications are described, including implementation and testing of nonconventional control philosophies for attitude control in case of primary failures. The development of algorithms using the IAFSIM as a fundamental tool of research is demonstrated. ESA

N92-24760# Academy of Sciences (USSR), Moscow. Inst. of Applied Mathematics.

DYNAMICS OF AEROSPACE SHUTTLES

Y. G. SIKHARULIDZE, A. V. BUROV, and V. S. LADYGIN *In* ESA, Spacecraft Flight Dynamics p 307-310 Dec. 1991
Copyright Avail: NTIS HC/MF A25; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The controlled motion of an aerospace shuttle descending through the atmosphere is analyzed by using a mathematical modeling. The shuttle model includes a bank of aerodynamic characteristics, geometry, parameters of the reaction control system and aerodynamic control surfaces, algorithms of the control system, etc. The model of perturbed atmosphere describes the environment. In numerical integration of the motion equations certain difficulties arise because of discontinuities in the right hand side due to the switch on of orientation engines as well as small step of integration (0.03 to 0.05 s) and long time of descent through the atmosphere (1800 to 2000 s). Methods of increasing the accuracy of calculations by improving the models and computational techniques used are discussed. ESA

N92-25315# Sandia National Labs., Albuquerque, NM.

JOINT COMPUTATIONAL AND EXPERIMENTAL AERODYNAMICS RESEARCH ON A REENTRY VEHICLE

1991 9 p Presented at the AGARD Fluid Dynamics Panel

Symposium on Theoretical and Experimental Methods in Hypersonic Flows, Torino, Italy, 5-7 May 1992
(Contract DE-AC04-76DP-00789)
(DE91-017315; SAND-91-1839C; CONF-920534-1-EXT-ABST)
Avail: NTIS HC/MF A02

This paper seeks to improve the synergism between computational aerodynamics and wind tunnel experimentation. In this paper, experimental and computational results are presented for a hypersonic vehicle configuration at Mach 8. Comparisons are made between experimental and computational results in order to improve the accuracy of both approaches. The basic vehicle configuration is a spherically blunted cone with a slice parallel with the axis of the vehicle. The half-angle of the cone is 10 degrees and the ratio of spherical nose radius to base radius is 10 percent. Onto the slice portion of the vehicle can be attached flaps with three different deflection angles; 10, 20, and 30 deg. All of the experimental results were obtained in the Sandia Mach 8 long duration, blow-down, hypersonic wind tunnel. Flow visualization results include surface oil flow, spark schlieren, and liquid crystal photographs and video. The liquid crystals were used as an aid in verifying that a laminar boundary layer existed over the entire body. An extensive uncertainty analysis was conducted to estimate quantitatively the accuracy of the measurement. Computational aerodynamic force and moment predictions are compared with the wind tunnel data. The Sandia parabolized Navier-Stokes code is used to generate solutions for the sliced vehicle (no flap) and partial solutions for the flapped vehicle. For the geometry with the flap, an axially separated flow occurs and a time iterative Navier-Stokes code is used to provide comparisons with the data. This paper presents a portion of the results given in earlier works and also discusses new experimental results with this configuration. DOE

N92-25374# National Space Development Agency, Ibaraki (Japan).

DESIGN OF ORBITAL RE-ENTRY EXPERIMENT VEHICLE AND OUTLINE OF THE EXPERIMENT

TOSHIO AKIMOTO, TOMOYUKI KOBAYASHI, MOTOYUKI INABA, TATSUSHI IZUMI, and ISAO KAWANO *In* its Preprints of NASDA's 6th Technical Symposium p 53-93 5 Jun. 1991 In JAPANESE; ENGLISH summary
Avail: NTIS HC/MF A06

The National Space Development Agency of Japan (NASDA) plans an Orbital Re-entry Experiment (OREX) in the winter of 1993 as part of a study of the H-2 Orbiting Plane (HOPE). There are some critical technical subjects in developing HOPE. Especially, relating to atmospheric re-entry, critical items are estimating aerodynamic and aerodynamic heating characteristics of the vehicle in the hypersonic region, and developing heat-resistance materials and thermal protection systems. In order to acquire basic data about these items, OREX is planned. In this experiment, an experimental vehicle will be launched and inserted into orbit by the first flight of the H-2 Launch Vehicle, and re-enter into the atmosphere afterward. During atmospheric re-entry, data about aerodynamic heating, etc., will be acquired. Author (NASDA)

N92-26129*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

TRANSONIC TURBINE BLADE CASCADE TESTING FACILITY

VINCENT G. VERHOFF, WILLIAM P. CAMPERCHIOLI, and ISAAC LOPEZ 1992 13 p Presented at the 17th Aerospace Ground Testing Conference, Nashville, TN, 6-8 Jul. 1992; sponsored in part by AIAA
(Contract DA PROJ. 1L1-61102-AH-45; RTOP 505-62-84)
(NASA-TM-105646; E-7002; NAS 1.15:105646; AVSCOM-TR-C-016; AIAA PAPER 92-4034) Avail: NTIS HC/MF A03

NASA LeRC has designed and constructed a new state-of-the-art test facility. This facility, the Transonic Turbine Blade Cascade, is used to evaluate the aerodynamics and heat transfer characteristics of blade geometries for future turbine applications. The facility's capabilities make it unique: no other facility of its kind can combine the high degree of airflow turning, infinitely

adjustable incidence angle, and high transonic flow rates. The facility air supply and exhaust pressures are controllable to 16.5 psia and 2 psia, respectively. The inlet air temperatures are at ambient conditions. The facility is equipped with a programmable logic controller with a capacity of 128 input/output channels. The data acquisition system is capable of scanning up to 1750 channels per sec. This paper discusses in detail the capabilities of the facility, overall facility design, instrumentation used in the facility, and the data acquisition system. Actual research data is not discussed. Author

11

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; and propellants and fuels.

A92-36900

EVALUATION OF NO(X) MECHANISMS FOR LEAN, PREMIXED COMBUSTION

R. A. CORR, P. C. MALTE, and N. M. MARINOV (Washington, University, Seattle) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 114, no. 2, April 1992, p. 425-434. Research supported by University of Washington. refs (ASME PAPER 91-GT-257) Copyright

Experiments and chemical-kinetics models are presently used to ascertain the formation characteristics for oxides of nitrogen in a lean, premixed, atmospheric-pressure jet-stirred laboratory reactor. Attention is given to two fuels: ethylene, which is important as a combustion intermediate, and methane, which is the main component of natural gas. NO(x) is in both cases found to increase with decreasing loading, due to the development of a centerline hot-spot when the reactor is lightly loaded. At other reactor loadings, NO(x) levels are only slightly elevated for the nonpremixed mode, relative to the premixed, due to intense mixing. A switch to methane fuel is noted to reduce NO(x) by about 25 percent; prompt NO formation is found to be the basis of NO(x) generation. O.C.

A92-36964

SWIRL AND FUEL COMPOSITION EFFECTS ON BORON COMBUSTION IN SOLID-FUEL RAMJETS

R. PEIN and F. VINNEMEIER (DLR, Institut fuer Chemische Antriebe und Verfahrenstechnik, Hardhausen am Kocher, Federal Republic of Germany) Journal of Propulsion and Power (ISSN 0748-4658), vol. 8, no. 3, May-June 1992, p. 609-614. Previously cited in issue 20, p. 3095, Accession no. A89-47150. refs Copyright

A92-38111* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

INFLUENCE OF AIR VELOCITY ON THE HABIT OF ICE CRYSTAL GROWTH FROM THE VAPOR

V. W. KELLER (NASA, Marshall Space Flight Center, Huntsville, AL) and J. HALLETT (Nevada, University, Reno, NV) Journal of Crystal Growth (ISSN 0022-0248), vol. 60, 1982, p. 91-106. refs (Contract NSF ATM-79-20399) Copyright

The effect of air velocity on the growth behavior of ice crystals growing from water vapor was investigated at temperatures between 0 and -35 C and at supersaturation levels ranging from 2 to 40 percent, using a laboratory chamber in which it was possible to make these variations. It was found that crystal growth was most sensitive to changes in the air velocity at temperatures near -4 C and -15 C where, near water saturation, the introduction of only a 5 cm/s air velocity induced skeletal transitions (columns to needles near -4 C and plates to dendrites near -15 C). The

experiments provide conditions which simulate growth of ice crystals in the atmosphere, where crystal growth takes place at or somewhat below water saturation. I.S.

A92-39672

EFFECT OF SUSTAINED HIGH TEMPERATURE EXPOSURE ON THE MECHANICAL PROPERTIES OF NICALON/AL2O3 COMPOSITES

A. S. FAREED, B. SONUPARLAK (Lanxide Corp., Newark, DE), P. A. CRAIG, and J. E. GARNIER (DuPont Lanxide Composites, Inc., Newark, DE) Ceramic Engineering and Science Proceedings (ISSN 0196-6219), vol. 13, no. 9-10, Sept.-Oct. 1992, p. 804-818. Research supported by Du Pont de Nemours & Co., Lanxide Corp., and DARPA. refs Copyright

The directed metal oxidation process was used to fabricate Nicalon fiber-reinforced alumina matrix composites. Flexural strengths, tensile strengths, and fracture toughnesses were measured between room temperature and 1400 C. Excellent mechanical property retention was observed up to 1200 C, with good retention to 1400 C. Stress rupture tests conducted at 1200 C in air demonstrated lifetimes greater than 1000 h with applied stresses in the range of 66 MPa. Successful engine and rig tests by manufacturers of man-rated as well as expendable turbine engines are also reported. Author

A92-39682

THE HARDNESS AND TOUGHNESS OF HIPED SILICON NITRIDE

R. BERRICHE, R. T. HOLT (National Research Council of Canada, Institute for Aerospace Research, Ottawa), S. N. KUMAR (Ceramics Kingston Ceramiques, Inc., Kingston, Canada), and T. M. MACCAGNO (McGill University, Montreal, Canada) Ceramic Engineering and Science Proceedings (ISSN 0196-6219), vol. 13, no. 9-10, Sept.-Oct. 1992, p. 966-977. Research supported by DND. refs Copyright

Silicon nitride with and without additives has been produced by hot isostatic pressing under different conditions. The HIP cycle parameters and grade of powder used have been found to affect the density, the hardness and the fracture toughness of the material produced. Sintering aids, on the other hand, have been found to affect the fracture toughness only. Materials HIPed with additives displayed a higher fracture toughness than materials HIPed without additives. Author

A92-39852* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

FLIGHT-VEHICLE MATERIALS, STRUCTURES, AND DYNAMICS - ASSESSMENT AND FUTURE DIRECTIONS. VOL. 3 - CERAMICS AND CERAMIC-MATRIX COMPOSITES

STANLEY R. LEVINE, ED. (NASA, Lewis Research Center, Cleveland, OH) New York, American Society of Mechanical Engineers, 1992, 372 p. For individual items see A92-39853 to A92-39867. (ISBN 0-7918-0661-8) Copyright

The present volume discusses ceramics and ceramic-matrix composites in prospective aerospace systems, monolithic ceramics, transformation-toughened and whisker-reinforced ceramic composites, glass-ceramic matrix composites, reaction-bonded Si3N4 and SiC composites, and chemical vapor-infiltrated composites. Also discussed are the sol-gel-processing of ceramic composites, the fabrication and properties of fiber-reinforced ceramic composites with directed metal oxidation, the fracture behavior of ceramic-matrix composites (CMCs), the fatigue of fiber-reinforced CMCs, creep and rupture of CMCs, structural design methodologies for ceramic-based materials systems, the joining of ceramics and CMCs, and carbon-carbon composites. O.C.

A92-39854* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

MONOLITHIC CERAMICS

THOMAS P. HERBELL and WILLIAM A. SANDERS (NASA, Lewis

Research Center, Cleveland, OH) IN: Flight-vehicle materials, structures, and dynamics - Assessment and future directions. Vol. 3 - Ceramics and ceramic-matrix composites. New York, American Society of Mechanical Engineers, 1992, p. 19-41. refs
Copyright

A development history and current development status evaluation are presented for SiC and Si₃N₄ monolithic ceramics. In the absence of widely sought improvements in these materials' toughness, and associated reliability in structural applications, uses will remain restricted to components in noncritical, nonman-rated aerospace applications such as cruise missile and drone gas turbine engine components. In such high temperature engine-section components, projected costs lie below those associated with superalloy-based short-life/expendable engines. Advancements are required in processing technology for the sake of fewer and smaller microstructural flaws. O.C.

A92-39861

FABRICATION AND PROPERTIES OF FIBER-REINFORCED CERAMIC COMPOSITES MADE BY DIRECTED METAL OXIDATION

GERHARD H. SCHIROKY, ALI S. FAREED, BIROL SONUPARLAK, C. T. LEE (Lanxide Corp., Newark, DE), and BOYD W. SORENSON (Du Pont Lanxide Composites, Inc., Newark, DE) IN: Flight-vehicle materials, structures, and dynamics - Assessment and future directions. Vol. 3 - Ceramics and ceramic-matrix composites. New York, American Society of Mechanical Engineers, 1992, p. 151-163. Research supported by DARPA. refs
Copyright

It has been established that ceramic fracture toughness can be improved by a factor of 5-10 through the incorporation of ceramic fibers; such composites cannot, however, be produced by the more conventional processing routes due to fiber damage. This has led to the development of the 'DIMOX' directed metal oxidation process, in which the ceramic matrix forms through the chemical oxidation of an Al alloy by oxygen, for Al₂O₃, or nitrogen, for AlN. The matrix directionally 'grows' from the alloy/fiber preform interface into the preform. Growth rates depend both on process conditions and the microstructural characteristics of the matrix. O.C.

A92-40409

THERMAL OXIDATION STABILITY OF AVIATION TURBINE FUELS

ROBERT N. HAZLETT (U.S. Navy, Naval Research Laboratory, Washington, DC) Philadelphia, PA, American Society for Testing and Materials (Monograph 1), 1991, 172 p. refs
(ISBN 0-8031-1248-3) Copyright

The present work on aviation fuel thermal-oxidative stability discusses stress conditions in aviation gas turbines, oxidation specification methods and limits, simulation test rigs for fuel thermal oxidation, and the physical effects of temperature, pressure, flow velocity, and test duration on thermal stability. Also discussed are the reduction of deposit formation via dissolved oxygen removal, metal effects on thermal stability, the effects of additives on thermal oxidation stability, high temperature fuel requirements in both commercial and military aircraft, and R&D goals for prospective aircraft fuels. O.C.

N92-25223# Oak Ridge National Lab., TN.

THE COST OF SILICON NITRIDE POWDER: WHAT MUST IT BE TO COMPETE?

S. DAS and T. R. CURLEE Feb. 1992 55 p
(Contract DE-AC05-84OR-21400)
(DE92-008710; ORNL-6694) Avail: NTIS HC/MF A04

The ability of advanced ceramic components to compete with similar metallic parts will depend in part on current and future efforts to reduce the cost of ceramic parts. This paper examines the potential reduction in part cost that could result from the development of less expensive advanced ceramic powders. The analysis focuses specifically on two silicon nitride engine components: roller followers, and turbocharger rotors. The results of the process-cost models developed for this work suggest that

reductions in the cost of advanced silicon nitride powder from its current level of about \$20 per pound to about \$5 per pound will not in itself be sufficient to lower the cost of ceramic parts below the current cost of similar metallic components. This work also examines the possibility of whether or not combinations of lower-cost powders and further improvements in other key technical parameters, to which costs are most sensitive, could push the cost of ceramics below the cost of metallics. Although these sensitivity analyses are reflective of technical improvements that are very optimistic, the resulting part costs are estimated to remain higher than similar metallic parts. Our findings call into question the widely-held notion that the cost of ceramic components must not exceed the cost of similar metallic parts if ceramics are to be competitive. Economic viability will ultimately be decided not on the basis of which part is less costly, but on an assessment of the marginal costs and benefits provided by ceramics and metallics. This analysis does not consider the benefits side of the equation. Our findings on the cost side of the equation suggest that the competitiveness of advanced ceramics will ultimately be decided by our ability to evaluate and communicate the higher benefits that advanced ceramic parts may offer. DOE

N92-25259# Lawrence Livermore National Lab., CA.

COMPOSITION MONITORING OF ELECTRON BEAM MELTING PROCESSES USING DIODE LASERS

L. V. BERZINS 20 Nov. 1991 5 p Presented at the 8th Conference on State-of-the-Art Electron Beam Melting and Refining, Reno, NV, 13-15 Nov. 1991
(Contract W-7405-ENG-48)
(DE92-009527; UCRL-JC-107999; CONF-911189-3) Avail: NTIS HC/MF A01

Electron beam melting processes are used to produce high purity alloys for a wide range of applications. Real time monitoring of the alloy constituents, however, has historically been difficult. Absorption spectroscopy using diode lasers provides a means for measuring constituent densities, and hence alloy composition, in real time. Diode lasers are suggested because they are inexpensive and require little maintenance. There is increasing interest in the composition and quality control of titanium alloys used in aircraft parts. For this reason we describe a proposed system for composition monitoring of titanium alloys. Performance and cost of the proposed system is addressed. We discuss the applicability of this approach to other alloys. DOE

N92-25816*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

STUDY OF SHOCK-INDUCED COMBUSTION USING AN IMPLICIT TVD SCHEME

SHAYNE YUNGSTER *In its* Computational Fluid Dynamics p 93-101 Feb. 1992 Original contains color illustrations
Avail: NTIS HC/MF A10; 11 functional color pages

The supersonic combustion flowfields associated with various hypersonic propulsion systems, such as the ram accelerator, the oblique detonation wave engine, and the scramjet, are being investigated using a new computational fluid dynamics (CFD) code. The code solves the fully coupled Reynolds-averaged Navier-Stokes equations and species continuity equations in an efficient manner. It employs an iterative method and a second order differencing scheme to improve computational efficiency. The code is currently being applied to study shock wave/boundary layer interactions in premixed combustible gases, and to investigate the ram accelerator concept. Results obtained for a ram accelerator configuration indicate a new combustion mechanism in which a shock wave induces combustion in the boundary layer, which then propagates outward and downstream. The combustion process creates a high pressure region over the back of the projectile resulting in a net positive thrust forward. H.A.

ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

A92-36606

AIRFIELD CONSTRUCTION (3RD REVISED AND ENLARGED EDITION) [STROITEL'STVO AERODROMOV /3RD REVISED AND ENLARGED EDITION/]

LEONID I. GORETSKII, ADOL'F M. BOGUSLAVSKII, VADIM A. SEREBRENIKOV, V. I. BARZDO, T. P. LESHCHITSKAIA, and S. M. POLOSIN-NIKITIN Moscow, Izdatel'stvo Transport, 1991, 368 p. In Russian. refs
(ISBN 5-277-01070-X) Copyright

The principal engineering aspects of airfield construction are discussed. In particular, attention is given to the fundamental principles and organizational aspects of airfield construction; excavation work and airfield layout; construction of drainage systems; foundations and pavements; and quality control and safety engineering. The discussion also covers the operation of various support plants, including concrete production and mixing, production of asphalt-concrete mixtures and organic binders, production of structural steel and reinforced concrete components, and operation of stone quarries and gravel pits. V.L.

A92-36611

NONSTATIONARY AEROHYDROELASTICITY OF SPHERICAL BODIES [NESTATSIONARNAIA AEROGIDROUPRUGOST' TEL SFERICHESKOI FORMY]

ANATOLII G. GORSHKOV and DMITRII V. TARLAPOVSKII (Moskovskii Aviatsionnyi Institut, Moscow, Russia) Moscow, Izdatel'stvo Nauka, 1990, 264 p. In Russian. refs
(ISBN 5-02-014006-6) Copyright

Results of systematic studies of the nonstationary interaction of spherical thin-walled and solid deformable bodies (layers) with elastic and acoustic media are reported. For the case of spherical (plane) shock wave diffraction by deformable obstacles submerged in an elastic (acoustic) medium, a series of exact solutions is obtained using the theory of generalized spherical waves and integral transformation methods. In problems involving impact and submersion of rigid and elastic spherical bodies (shells) in a half-space filled with an ideal fluid, current numerical methods are used in addition to analytical methods. V.L.

A92-36844

NUMERICAL SIMULATION OF DROPLET DEFORMATION IN CONVECTIVE FLOWS

ZHENG-TAO DENG and SAN-MOU JENG (Tennessee, University, Tullahoma) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1290-1297. Previously cited in issue 19, p. 3046, Accession no. A90-42773. refs
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A92-36846* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

CHARACTERISTIC-BASED ALGORITHMS FOR FLOWS IN THERMOCHEMICAL NONEQUILIBRIUM

ROBERT W. WALTERS, PASQUALE CINNELLA, DAVID C. SLACK (Virginia Polytechnic Institute and State University, Blacksburg), and DAVID HALT (McDonnell Douglas Corp., Saint Louis, MO) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1304-1313. Previously cited in issue 08, p. 1159, Accession no. A90-23708. refs
(Contract NAG1-776)
Copyright

A92-36851

INCLUSION PRINCIPLE FOR THE RAYLEIGH-RITZ BASED SUBSTRUCTURE SYNTHESIS

LEONARD MEIROVITCH and MOON K. KWAK (Virginia Polytechnic Institute and State University, Blacksburg) AIAA Journal (ISSN 0001-1452), vol. 30, no. 5, May 1992, p. 1344-1351. Previously cited in issue 12, p. 2000, Accession no. A91-32082. refs
(Contract F49620-89-C-0045)
Copyright

A92-36893

FRACTURE MECHANICS APPROACH TO CREEP GROWTH IN WELDED IN738LC GAS TURBINE BLADES

W. P. FOO and R. CASTILLO (Westinghouse Canada, Inc., Power Generation Technology Div., Hamilton) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 114, no. 2, April 1992, p. 275-283. refs
(ASME PAPER 91-GT-119) Copyright

The creep-crack growth rate in air of the HiPed and fully heat treated IN738LC turbine blade superalloy was ascertained at first-stage turbine blade tip temperature; attention was also given to associated crack growth behavior. The creep crack growth rate vs crack tip stress intensity factor ($K_{sub I}$) relation is found to support the applicability of $K_{sub I}$ as a suitable correlating parameter for creep crack growth of this Ni-base superalloy. An excellent approximation of the stress intensity factor under service conditions in the crack tip vicinity was obtained via the WECAN FEM analysis. It is established that $K_{sub I}$, under normal loading conditions, will not be able to drive the transverse, through-the-wall-thickness blade tip crack studied. O.C.

A92-36899

A NEW METHOD FOR CALCULATING BURST SPEED OF AEROENGINE DISKS

QILIN HONG, QIXUAN ZHENG, PING WANG, and GUICANG HOU (Beijing University of Aeronautics and Astronautics, People's Republic of China) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 114, no. 2, April 1992, p. 334-337. refs
(ASME PAPER 91-GT-121) Copyright

An approximate analytical large deformation method, based on the Nadai deformation theory, for calculating the burst speed of aeroengine disks, is presented in this paper. The basic equations are developed and the calculation procedures are illustrated. The burst speeds are calculated for some tested disks, and the calculation results are compared with the test results; the differences between two results are shown to be less than 8 percent. This shows that the new method is both simple and convenient. Therefore, it could be employed in the development of aeroengine disks. Author

A92-36901

UNSTEADY FLOW WITHIN CENTRIFUGAL COMPRESSOR CHANNELS UNDER ROTATING STALL AND SURGE

S. MIZUKI (Hosei University, Tokyo, Japan) and Y. OOSAWA (NTT, Tokyo, Japan) ASME, Transactions, Journal of Turbomachinery (ISSN 0889-504X), vol. 114, no. 2, April 1992, p. 312-320. refs
(ASME PAPER 91-GT-85) Copyright

Unsteady flow patterns throughout a centrifugal compressor system during the rotating stall and the surge were measured experimentally. Various kinds of unsteady behavior of the flow appeared both continuously and suddenly as the flow rate decreased. The part-span stall, the full-span stall, the mild and deep stalls, and the deep surge appeared clearly. The fluctuations caused by the full-span stall were seen even during surge and affected the flow within the scroll through the vaneless diffuser. The experimental results were compared with those computed by the lumped parameter theory. Good agreements between them were obtained when appropriate values were selected for the lumped parameters. Author

A92-36948

SEEING BENEATH THE SURFACE WITH NDE

ALAN S. BROWN Aerospace America (ISSN 0740-722X), vol. 30, no. 5, May 1992, p. 26-30, 40.

Copyright

A review is presented of new noninvasive testing techniques under development for improved methods of examining aging aircraft to determine incipient parts failures. The FAA has focused its efforts on inspection technologies to detect flaws, cracks, delaminations, debonds, and particularly cracks before they grow threatening. These systems will also detect damage not visible on the surface of composites. Attention is given to research conducted on various NDE technologies including X-rays, eddy current, AE, holography, pulsed thermography, shearography, and neutron radiation.

R.E.P.

A92-37188* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

ONE JOULE OUTPUT FROM A DIODE-ARRAY-PUMPED ND:YAG LASER WITH SIDE-PUMPED ROD GEOMETRY

JEFFREY J. KASINSKI, WILL HUGHES, DON DIBIASE, PATRICK BOURNES, and RALPH BURNHAM (Fibertek, Inc., Herndon, VA) IEEE Journal of Quantum Electronics (ISSN 0018-9197), vol. 28, no. 4, April 1992, p. 977-985. Research supported by U.S. Navy, U.S. Army, SDIO, NASA, and DARPA. refs

Copyright

Output of 1.25 J per pulse (1.064 micron) with an absolute optical efficiency of 28 percent and corresponding electrical efficiency of 10 percent was demonstrated in a diode-array-pumped Nd:YAG laser using a side-pumped rod geometry in a master-oscillator/power-amplifier configuration. In Q-switched operation, an output of 0.75 J in a 17-ns pulse was obtained. The fundamental laser output was frequency doubled in KTP with 60 percent conversion efficiency to obtain 0.45 J in a 16-ns pulse at 532 nm. The output beam had high spatial quality with pointing stability better than 40 microrad and a shot-to-shot pulse energy fluctuation of less than ± 3 percent.

I.E.

A92-37395

RELIABILITY ANALYSIS OF FATIGUE LIFE OF A STRUCTURAL SYSTEM

CONG DONG and QINGXIONG YANG (Northwestern Polytechnical University, Xian, People's Republic of China) Northwestern Polytechnical University, Journal (ISSN 1000-2758), vol. 10, no. 2, April 1992, p. 252-258. In Chinese. refs

A method is presented for enumerating the significant fatigue failure modes of a structural system and analyzing the failure-evolving history. This method is called the stage-fatigue-life branch-and-bound method. The method makes it possible to discover all significant failure modes; a proof to the effect is provided. The algorithm proposed for this method is completely automatic and makes analysis and computation of the fatigue life reliability of a large-scale engineering structure feasible. The algorithm is rigorously convergent; good efficiency in convergence is obtained by employing adjustable branching bounds. The concept of normalized damage factor is introduced, and a rational randomized accumulative damage rule is established. It is shown that an approximate value of system failure probability can be estimated by means of the failure probability of the main significant failure mode.

P.D.

A92-37559

RIGID AND FLEXIBLE JOINT MODELLING IN MULTIBODY DYNAMICS USING FINITE ELEMENTS

A. CARDONA (Universidad Nacional del Litoral, Santa Fe, Argentina), M. GERADIN (Liege, Universite, Belgium; ONERA, Chatillon, France), and D. B. DOAN (Liege, Universite, Belgium) (World Congress on Computational Mechanics, 2nd, Stuttgart, Federal Republic of Germany, Aug. 27-31, 1990, Selected Papers. A92-37547 15-31) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 89, no. 1-3, Aug. 1991, p. 395-418. refs

Copyright

This paper presents a finite element formulation of mechanical joints for multibody dynamics. The augmented Lagrangian procedure is used to express constraints of both holonomic and nonholonomic types. The method is first demonstrated on the holonomic case of the hinge joint. It is then used to develop a wheel capable of radial deformation, slipping, breaking and coupled lateral/torsional deformations. Both joints are formulated with the objective of being integrated into a multiple purpose finite element software for flexible mechanism analysis. Two application examples are presented to demonstrate the effectiveness of the method: the dynamic deployment of a curved reflector in space and the simulation of a nose landing gear during touch-down.

Author

A92-37868

A HIGH-RESOLUTION EULER SOLVER BASED ON MULTIGRID, SEMI-COARSENING, AND DEFECT CORRECTION

WIM A. MULDER (California, University, Los Angeles) Journal of Computational Physics (ISSN 0021-9991), vol. 100, no. 1, May 1992, p. 91-104. refs

(Contract NSF DMS-88-11863; N00014-86-K-0691)

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The application of an $O(N)$ method for the computation of stationary solutions of the Euler equations of inviscid compressible gasdynamics to higher-order discretizations is discussed. Two-grid analysis for the linear constant-coefficient case shows that it is difficult to obtain uniformly good convergence rates for a higher-order scheme because of waves perpendicular to stream lines. The convergence to a point where the residual of the total error (the sum of the iteration error and the discretization error) is of the order of the truncation error can be obtained in about seven defect correction cycles, according to estimates of the linear constant-coefficient equations. The result is explored for the nonlinear case by a number of illustrated numerical experiments.

P.D.

A92-38163 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A LOW-POWER, HIGH-EFFICIENCY KA-BAND TWTA

A. N. CURREN, J. A. DAYTON, JR., R. W. PALMER, D. A. FORCE (NASA, Lewis Research Center, Cleveland, OH), R. N. TAMASHIRO, J. F. WILSON, L. DOMBRO (Hughes Aircraft Co., Torrance, CA), and W. L. HARVEY (JPL, Pasadena, CA) IN: 1991 International Electron Devices Meeting, Washington, DC, Dec. 8-11, 1991, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p. 581-584. refs

Copyright

A NASA-sponsored program is described for developing a high-efficiency low-power TWTA operating at 32 GHz and meeting the requirements for the Cassini Mission to study Saturn. The required RF output power of the helix TWT is 10 watts, while the dc power from the spacecraft is limited to about 30 watts. The performance level permits the transmission to earth of all mission data. Several novel technologies are incorporated into the TWT to achieve this efficiency including an advanced dynamic velocity taper characterized by a nonlinear reduction in pitch in the output helix section and a multistage depressed collector employing copper electrodes treated for secondary electron-emission suppression. Preliminary program results are encouraging: RF output power of 10.6 watts is obtained at 14-mA beam current and 5.2-kV helix voltage with overall TWT efficiency exceeding 40 percent.

Author

A92-38216

ROBOTICS APPLICATION IN AEROSPACE MANUFACTURING

MASANORI HIROSE (Mitsubishi Heavy Industries, Ltd., Tokyo, Japan) IN: International Aerospace Symposium 90, Nagoya, Japan, Nov. 26, 27, 1990, Proceedings. Nagoya, Japan, Nagoya Chamber of Commerce and Industry, 1990, p. 125-130. In Japanese.

The improvement of robots in terms of reliability and precision is discussed. The application of robots in airframe manufacturing lines including part fabrication, assembly, painting, and inspection

is presented. The development of end effectors and CAD/CAM related peripheral software is outlined. Y.P.Q.

A92-38225**FRETTING FATIGUE**

R. B. WATERHOUSE (Nottingham, University, England) International Materials Reviews (ISSN 0950-6608), vol. 37, no. 2, 1992, p. 77-97. refs

Copyright

Results of recent experimental and analytical investigations of fretting fatigue are reviewed. In particular, attention is given to the origin of fretting movement, initiation and propagation of fatigue cracks, effect of the principal variables on the fretting fatigue process, and the response of various materials to fretting fatigue. Methods of minimizing fretting fatigue are discussed. V.L.

A92-38275**MECHANICS AND THERMODYNAMICS OF PROPULSION (2ND REVISED AND ENLARGED EDITION)**

PHILIP G. HILL (British Columbia, University, Vancouver, Canada) and CARL R. PETERSON (MIT, Cambridge, MA) Reading, MA, Addison-Wesley Publishing Co., 1992, 764 p. refs (ISBN 0-201-14659-2) Copyright

The present volume proceeds under the principle that a few fundamental physical principles can with suitable application furnish students of mechanical and aeronautical engineering with an understanding of all aspects of aircraft and spacecraft propulsion. This methodology can further yield usefully quantitative assessments of performance, and indicate prospects for further improvement. Attention is given to the jet propulsion principle, the mechanics and thermodynamics of fluid flow, the thermodynamics of aircraft gas turbine engines, axial compressors and turbines, centrifugal compressors, chemical propellant rocket engine operation and performance, turbomachinery for liquid propellant rockets, and electrical rocket propulsion. O.C.

A92-38770**A METHOD TO DETERMINE PROPAGATION DIRECTION OF COMPRESSIVE FRACTURE IN CARBON-FIBRE COMPOSITES**

E. S. GREENHALGH and P. C. COX (Defence Research Agency, Aerospace Div., Farnborough, England) Composite Structures (ISSN 0263-8223), vol. 21, no. 1, 1992, p. 1-7. refs

Copyright

An investigation has been carried out in which laminates with differing surface plies were tested to failure and subsequently examined. It was found that the size, distribution, and position of the splits could be used to determine the direction of crack propagation. The results were consistent, especially for specimens with +45/-45 deg outer plies, the most common surface lay-up found in structural design. The technique has been successfully employed to ascertain the source and sequence of failure of various composite structures. Author

A92-38851**INTERNATIONAL SYMPOSIUM ON ENGINEERING TURBULENCE MODELLING AND MEASUREMENTS, DUBROVNIK, YUGOSLAVIA, SEPT. 24-24, 1990, SELECTED PAPERS**

W. RODI, ED. (Karlsruhe, Universitaet, Federal Republic of Germany) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, 174 p. For individual items see A92-38852 to A92-38868.

Copyright

The papers presented in this volume focus on measurements in turbulent flows, including the measurement of turbulence properties. Papers are included on designing experiments to test closure hypotheses, flow visualization in a transverse cross section of an open-channel flow, Reynolds stress budget in the outwash jet arising from colliding jet walls, and experiments on turbulent flow due to an enclosed rotating disk. Other topics discussed are detection of coherent structures in a turbulent boundary layer using a scanning LDV system, effect of controlled longitudinal vortex

arrays on the development of a turbulent boundary layer, and flow regimes in the cove regions between a slat and wing and between a wing and flap in a multielement airfoil. V.L.

A92-38866**INFLUENCE OF INLET CONDITIONS ON THE FLOWFIELD IN A MODEL GAS TURBINE COMBUSTOR**

YUJI IKEDA, YUJI YANAGISAWA, SHIGEO HOSOKAWA, and TSUYOSHI NAKAJIMA (Kobe University, Japan) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 390-400. refs

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A model combustor was designed to demonstrate the fundamental flow structure. A water model was used with a simple configuration of swirl flow and four crossflows. Velocity measurements were carried out at the swirler exit, upstream of the swirler, at the jet exits, and in the whole region of the chamber using two fiber laser Doppler velocimeters. The structure of the recirculating swirl flow was investigated in a primary zone of the model combustor. The measured results are compared with calculations based on a modified version of the k-epsilon model. The results show that the flowfield is sensitive to inlet conditions, and the position and size of the recirculation vortex formed in the primary region can be predicted satisfactorily. V.L.

A92-38867**LDV MEASUREMENTS OF THE FLOWFIELD IN A SIMULATED COMBUSTOR WITH AXIAL AND SIDE INLETS**

T.-M. LIOU and Y.-Y. WU (National Tsing Hua University, Hsinchu, Republic of China) (International Symposium on Engineering Turbulence Modelling and Measurements, Dubrovnik, Yugoslavia, Sept. 24-28, 1990, Selected Papers. A92-38851 15-34) Experimental Thermal and Fluid Science (ISSN 0894-1777), vol. 5, no. 3, May 1992, p. 401-409. refs (Contract NSCRC-80-0401-E007-02)

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The axial and transverse mean velocity and turbulence intensity components as well as Reynolds stresses and turbulent kinetic energy were measured by using a four-beam two-color LDV system for the isothermal flowfield of a simulated combustor that consisted of a plexiglass rectangular duct with two opposing 90-deg side inlets and one axial inlet. The Reynolds number, based on the air density, combustor height, and bulk mean velocity, was 45,600. The ratio of the axial-inlet to side-inlet jet momentum was 1.28. Various flow regions are characterized by the measured mean flow pattern. The LDV-measured mean reattachment length of the separating bubble compares fairly well with the corresponding flow visualization photograph. Moreover, the lengths needed to reach both unidirectional flow and fully developed mean flow are determined. Regions where turbulence is anisotropic and where turbulent kinetic energy and shear stresses dominate are also identified. The information presented will be useful in testing and developing combustor models in this area. Author

A92-38922**THE EFFECTS OF UNSTEADY PERTURBATION ON VORTEX BREAKDOWN**

JIEYUAN PAN and XIAOLI PAN (Beijing University of Aeronautics and Astronautics, People's Republic of China) Acta Aerodynamica Sinica (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 135-139. In Chinese. refs

The effects of unsteady perturbation on vortex breakdown are investigated in the case of a vortex generator. The experimental results indicate that, either in the case of spiral or bubble breakdown, the velocity approaches zero as the breakdown point is approached. When unsteady perturbation is imposed on the flow, the velocities near the vortex axis increase and the breakdown is delayed. In certain combinations of steady flow parameters the type of breakdown can be changed from bubble to spiral and the breakdown is also delayed. Analysis using the generalized Lagrange method indicates that these phenomena might be due to flow

resonance. Experimental results on a delta wing with an oscillating leading flap are presented. It is shown that the leading edge vortex breakdown can be delayed by the oscillation of leading edge flaps and there is an optimum frequency. C.D.

A92-39009* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

EFFECTS OF T-TABS AND LARGE DEFLECTIONS IN DOUBLE CANTILEVER BEAM SPECIMEN TESTS

RAJIV A. NAIK (Analytical Services and Materials, Inc., Hampton, VA), JOHN H. CREWS, JR. (NASA, Langley Research Center, Hampton, VA), and KUNIGAL N. SHIVAKUMAR (Analytical Services and Materials, Inc., Hampton, VA) IN: Composite materials: Fatigue and fracture. Vol. 3. Philadelphia, PA, American Society for Testing and Materials, 1991, p. 169-186. Previously announced in STAR as N90-16868. refs

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A simple strength of materials analysis was developed for a double-cantilever beam (DCB) specimen to account for geometric nonlinearity effects due to large deflections and T-tabs. A new DCB data analysis procedure was developed to include the effects of these nonlinearities. The results of the analysis were evaluated by DCB tests performed for materials having a wide range of toughnesses. The materials used in the present study were T300/5208, IM7/8551-7, and AS4/PEEK. Based on the present analysis, for a typical deflection/crack length ratio of 0.3 (for AS4/PEEK), T-tabs and large deflections cause a 15 and 3 percent error, respectively, in the computer Mode I strain energy release rate. Design guidelines for DCB specimen thickness and T-tab height were also developed in order to keep errors due to these nonlinearities within 2 percent. Based on the test results, for both hinged and tabbed specimens, the effects of large deflection on the Mode I fracture toughness ($G_{sub Ic}$) were almost negligible (less than 1 percent) in the case of T300/5208 and IM7/8551-7; however, AS4/PEEK showed a 2 to 3 percent effect. The effects of T-tabs $G_{sub Ic}$ were more significant for all the materials with T300/5208 showing a 5 percent error, IM7/8551-7 a 15 percent error, and, AS4/PEEK a 20 percent error. Author

A92-39281

ACTIVE VIBRATION CONTROL OF SMART STRUCTURAL MATERIALS

W. B. WU and M. J. TZENG (Missouri-Rolla, University, Rolla) IN: Joint U.S./Japan Conference on Adaptive Structures, 1st, Maui, HI, Nov. 13-15, 1990, Proceedings. Lancaster, PA, Technomic Publishing Co., Inc., 1991, p. 882-914. refs

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Active vibration control of smart structural materials were investigated through the numerical simulation and the experimental testing. Characterization of passive and active damping was emphasized by means of the structural modal testing technique. Measured results were incorporated into the computer simulation. Comparisons of results are presented. Author

A92-39308

HOW TO PROMOTE ERROR TOLERANCE IN COMPLEX SYSTEMS IN THE CONTEXT OF SHIPS AND AIRCRAFT

JAMES REASON (Manchester, Victoria University, England) IN: Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 16.1-16.10. refs

Copyright

This paper looks at error tolerance from an organizational rather than an individual perspective. Many shipping and aircraft accidents have their primary origins in latent human failures; that is, fallible management decisions whose consequences may lie dormant for long periods before coming into adverse conjunction with local triggering factors to cause an accident. The paper reviews current ideas regarding the causes of accidents in complex, well-defended systems and equates the promotion of error tolerance with safety management procedures designed to detect and neutralized the consequences of these latent failures before they contribute to catastrophic accidents. Author

A92-39558

A KALMAN FILTER MECHANIZATION FOR THE BARO-INERTIAL VERTICAL CHANNEL

J. S. AUSMAN (Litton Aero Products, Guidance and Control Systems Div., Woodland Hills, CA) IN: Institute of Navigation, Annual Meeting, 47th, Williamsburg, VA, June 10-12, 1991, Proceedings. Washington, DC, Institute of Navigation, 1991, p. 153-159. refs

The paper develops a Kalman filter vertical channel mechanization based on a linear error model for scale factor variation with altitude that varies linearly with altitude, passing through zero at 26,000 ft. Simulations of the resulting vertical channel performance show it to be much superior to either the conventional mechanizations or to Kalman filter mechanizations with altitude-independent baro scale factor error models. C.A.B.

A92-39930

MECHANICS PAN-AMERICA 1991; PAN-AMERICAN CONGRESS OF APPLIED MECHANICS, 2ND (PACAM II), UNIVERSIDAD TECNICA, VALPARAISO, CHILE, JAN. 2-5, 1991, SELECTED AND REVISED PROCEEDINGS

PABLO A. KITTL, ED. (Universidad de Chile, Santiago) and DEAN T. MOOK, ED. Congress sponsored by American Academy of Mechanics, NSF, CONICYT, et al. Applied Mechanics Reviews (ISSN 0003-6900), vol. 44, no. 11, pt. 2, Nov. 1991, 306 p. For individual items see A92-39931 to A92-39950.

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Topics presented include an investigation of finite deformations and shear banding, a separated solution procedure for bending of circular plates with circular holes, a photoelastic study of friction, and an eigenvalue problem for uncertain systems. Also presented are the panel method control in 3D hyperbolic grid generation, spheroidal sliding inclusion in an elastic half-space, shear deformation and buckling of columns, the harmonious and transient behavior of rotors, and the dynamics of cracked rotating blades. R.E.P.

A92-39944

BEHAVIOR OF THIN-WALLED BEAMS MADE OF ADVANCED COMPOSITE MATERIALS AND INCORPORATING NON-CLASSICAL EFFECTS

LIVIU LIBRESCU and OHSEOP SONG (Virginia Polytechnic Institute and State University, Blacksburg) (Mechanics Pan-America 1991; Pan-American Congress of Applied Mechanics, 2nd /PACAM II/, Valparaiso, Chile, Jan. 2-5, 1991, Selected and Revised Proceedings. A92-39930 16-31) Applied Mechanics Reviews (ISSN 0003-6900), vol. 44, no. 11, pt. 2, Nov. 1991, p. S174-S180. refs

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Several results concerning the refined theory of thin-walled beams of arbitrary closed cross-section incorporating nonclassical effects are presented. These effects are related both with the exotic properties characterizing the advanced composite material structures and the nonuniform torsional model. A special case of the general equations is used to study several problems of cantilevered thin-walled beams and to assess the influence of the incorporated effects. The results presented in this paper could be useful toward a more rational design of aeronautical or aerospace constructions, as well as of helicopter or tilt rotor blades constructed of advanced composite materials. Author

A92-39958

REQUIREMENTS FOR HIGH FLUX COOLING OF FUTURE AVIONICS SYSTEMS

MICHAEL J. MACKOWSKI (McDonnell Douglas Missile Systems Co., Saint Louis, MO) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 9 p. refs (SAE PAPER 912104) Copyright

An industry survey was performed to determine future needs for high flux heat removal in advanced electronics systems. The focus of the survey was to determine technology development requirements for military avionics systems. Commercial electronics suppliers were included because many high-power devices are

being developed in that part of the industry. This paper presents a summary of all of the interviews and literature reviewed. The summary is sorted by broad application categories, which are: (1) commercial digital systems, (2) military data processors, (3) power processors, and (4) radar and optical systems. For applications expected to be fielded in five to ten years, the outlook is for steady state flux levels of 100 watts per chip for digital processors and several hundred watts per device for power control applications using advanced MOSFETs or MOS-controlled thyristor technology. Author

A92-39959**FLEXIBLE HEAT PIPE COLD PLATES FOR AIRCRAFT THERMAL CONTROL**

NELSON GERNERT, DAVID SARRAF (Thermacore, Inc., Lancaster, PA), and MARC STEINBERG (U.S. Navy, Naval Air Development Center, Warminster, PA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 11 p. refs (SAE PAPER 912105) Copyright

This paper describes the development of flexible heat pipe cold plate (FHPCP) technology for aircraft thermal control. Four different FHPCP's were constructed for a variety of difficult aircraft cooling problems. This included an electronics package embedded in a moving actuator, and a new digital computer installed in a fighter aircraft upgrade. In each application, a cold plate transfers the electronics' heat to the most convenient heat sink by an integrally connected flexible heat pipe. The heat pipe is flexible to allow relative motion between the package to be cooled and the heat sink. It also allows cooling to be provided to surfaces in awkward locations relative to the heat sink. The connections to the heat sink can be anything from convective air cooled fins to solid plates bolted on the aircraft's structure. The cold plates were designated to be installed in the gravity-assisted orientation, but the incorporation of a high performance wick structure allows operation in mild against-gravity conditions. Author

A92-39987**TURBINE BLADE HEAT TRANSFER PREDICTION USING COUPLED TURBULENT PRANDTL NUMBER AND TRANSITION MODELS**

KEVIN W. WHITAKER (Alabama, University, Tuscaloosa) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 11 p. refs (SAE PAPER 912152) Copyright

A study was undertaken to improve the prediction of heat transfer coefficients on the suction surface of turbine blades. The study specifically investigated the effects of coupling turbulent Prandtl number models with boundary layer transition models. A two-dimensional boundary layer code, STAN5, was selected and the turbulence model modified by incorporating several turbulent Prandtl number and boundary layer transition models found in the literature. Results indicated that subtle effects were attributable to the modified turbulence model. However, desired improvements were not obtained in the heat transfer coefficient predictions. It appears that boundary layer transition models predicting natural transition are not appropriate for use in a turbine blade flowfield. Author

A92-40012**PROCESS CONTROL CHALLENGES DURING THE MANUFACTURE OF LARGE SUPERPLASTICALLY FORMED/DIFFUSION BONDED STRUCTURE**

WALTER LEODOLTER (Barnes Group, Inc., Flameco Div., Ogden, UT) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 8 p. (SAE PAPER 912195) Copyright

An account is given to the adaptation of SPF/DF processing for the fabrication of such large, complex components as the nacelle structures of the C-17 Advanced Military Airlifter. The four-sheet SPF/DB technique is used to produce a compound-curved Ti-6Al-4V assembly composed of four sandwich segments 80 x 120 cm in size. Attention is given to the quality

criteria that such be satisfied, as well as the difficulties encountered in efforts to predict and control the SPF/DB process. Technical problems encountered included the effects of thermal nonuniformities associated with the large-scale tooling used in this manufacturing effort. O.C.

A92-40018**ADVANCES IN AIRCRAFT COMPONENT SUPERPLASTIC FORMING/DIFFUSION BONDING TECHNOLOGY**

C. F. BARTH (Jet Die/Barnes Aerospace Group, Lansing, MI) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 15 p. (SAE PAPER 912216) Copyright

An account is given of a specific advancement in SPF/DB technology, the 'Sutton core process' (SCP), which promises to have wide applicability in both airframe and powerplant manufacture. SCP is a four-sheet process in which two core sheets are used to form sandwich-corelike internal structures, while the two outer sheets define aerodynamically/mechanically functional contours. Attention is given to the application of SCP for fabrication of net-shape gas turbine rotating components; SCP can yield airfoil weight reductions of the order of 50-60 percent, while retaining dynamic response capabilities approaching those of solid airfoils. Cost reductions of the order of 60 percent are also anticipated. O.C.

A92-40020**ADVANCED BALANCING USING LASER MACHINING**

J. F. WALTON, M. CRONIN (Mechanical Technology, Inc., Latham, NY), and RAMESH MEHTA (Textron Lycoming, Stratford, CT) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 11 p. Research sponsored by Mechanical Technology, Inc. refs (Contract DAAE07-89-C-R112) (SAE PAPER 912218) Copyright

A laser-balancing system is described, and materials machined with the system are examined by means of fatigue testing and comparisons with as-machined components. An Nd:YAG laser is used in the automated system to machine rotating components, and the components are examined to study the effects of the laser material-removal process. Materials from turbine engines are handground, machined, or laser-machined, and fatigue testing is used in conjunction with SEM to study the effects on material fatigue life. Laser machining is shown to degrade the fatigue life more than handgrinding, but the material-removal process does not reduce the life of a tested shaft component. It is suggested that fatigue tests of transverse laser machining be conducted to assess possible techniques for refining the laser removal process. C.C.S.

A92-40024* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

RECENT MANUFACTURING ADVANCES FOR SPIRAL BEVEL GEARS

ROBERT F. HANDSCHUH and ROBERT C. BILL (NASA, Lewis Research Center; U.S. Army, Propulsion Directorate, Cleveland, OH) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 14 p. Previously announced in STAR as N91-31654. refs (SAE PAPER 912229) Copyright

The U.S. Army Aviation Systems Command (AVSCOM), through the Propulsion Directorate at NASA Lewis Research Center, has recently sponsored projects to advance the manufacturing process for spiral bevel gears. This type of gear is a critical component in rotary-wing propulsion systems. Two successfully completed contracted projects are described. The first project addresses the automated inspection of spiral bevel gears through the use of coordinate measuring machines. The second project entails the computer-numerical-control (CNC) conversion of a spiral bevel gear grinding machine that is used for all aerospace spiral bevel gears. The results of these projects are described with regard to the savings effected in manufacturing time. Author

A92-40051

SYMPOSIUM ON TURBULENT SHEAR FLOWS, 8TH, TECHNICAL UNIVERSITY OF MUNICH, FEDERAL REPUBLIC OF GERMANY, SEPT. 9-11, 1991, PROCEEDINGS. VOLS. 1 & 2 Symposium supported by DLR, USAF, U.S. Army, et al. University Park, PA, Pennsylvania State University, 1991, p. Vol. 1, 513 p.; vol. 2, 484 p. For individual items see A92-40052 to A92-40141, A92-40143 to A92-40184.

The present volume on turbulent shear flows discusses wall flows, mixing layers, instrumentation, free shear flows, two phase flows, aerodynamic flows, unsteady flows, atmospheric flows, homogeneous flows, transition and control, large eddy simulations, closures, coherent structures, and rotation and curvature effects. Topics addressed include bursts and sources of pressure fluctuation in turbulent boundary layers, effects of adverse pressure gradients on mean flow and turbulence statistics in a boundary layer, the evolution of three-dimensionality in stable and unstable curved mixed layers, and the role of rolls and ribs in reacting mixing layers. Attention is given to a new method for visualization and measurement of turbulent flow patterns, the structure of turbulence in a simulated plane Couette flow, and large-scale structures in wakes behind axisymmetric bodies. Also discussed are 3D separated flows, particle dispersion in highly swirling turbulent flows, the breakdown of a circular jet into turbulence, and compressible turbulence subjected to shear and rapid compression. C.A.B.

A92-40052* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

COMPRESSIBILITY EFFECTS ON THE GROWTH AND STRUCTURE OF HOMOGENEOUS TURBULENT SHEAR FLOW G. A. BLAISDELL (Purdue University, West Lafayette, IN), W. C. REYNOLDS (Stanford University, CA; NASA, Ames Research Center, Moffett Field, CA), and N. N. MANSOUR (NASA, Ames Research Center, Moffett Field, CA) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 1-1-1 to 1-1-6. refs (Contract F49620-86-K-0022)

Direct numerical simulations of compressible homogeneous turbulent shear flow are used to provide insight into compressibility effects on turbulence. The simulations show a reduction in the growth rate of the turbulence compared to the incompressible case. Examination of the turbulent kinetic energy budget shows that the reduced growth rate is due to an increase in the dissipation rate due to the divergence of the velocity and to the pressure-dilatation correlation which acts to transfer energy between internal energy and kinetic energy. The structure of the turbulence is also examined. Visualizations of the flowfields reveal the presence of eddy shocklets. These shock structures are important contributors to the increased dissipation of compressible turbulence. A mechanism for the generation of the shocks is suggested. Author

A92-40080

PREDICTION OF THREE-DIMENSIONAL TURBULENT BOUNDARY LAYERS USING A SECOND-MOMENT CLOSURE NOBUYUKI SHIMA (Shizuoka University, Hamamatsu, Japan) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 8-2-1 to 8-2-6. refs

A second-moment closure, which was previously validated in various two-dimensional boundary layers, is applied to three kinds of three-dimensional boundary layers. The turbulence model faithfully reproduces a fully-developed pressure-driven flow; a skewed velocity profile itself does not cause difficulties in prediction. For a shear-driven flow and a flow on a swept wing, the predictions show limited success. It is also shown that the decrease in the structure parameter is partially accounted for by the effect of 'secondary' velocity gradient terms in the stress transport equations. Author

A92-40093

PARTICLE DISPERSION IN HIGHLY SWIRLING, TURBULENT FLOWS

E. BLUEMCKE, M. BRANDT, H. EICKHOFF, and C. HASSA (DLR, Institut fuer Antriebstechnik, Cologne, Federal Republic of Germany) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 10-5-1 to 10-5-6. refs

Transport processes of monosized droplets in a turbulent swirling shear layer were investigated experimentally and theoretically. A model experiment was designed that represents the spray dispersion produced by airblast atomizers. Based on the experimental results a stochastic dispersion model was developed. The analysis of the numerical results emphasizes the importance of an accurate description of gas phase turbulence characteristics. The implementation of a so-called 'Multiple-Particle-Option' enables the model to resolve instationary dispersion characteristics. Author

A92-40102

SECOND MOMENT CLOSURE PREDICTIONS OF JET-ON-JET IMPINGEMENT FLOWS

S. J. BAKER (Imperial College of Science, Technology, and Medicine, London, England) and J. J. MCGUIRK (Loughborough University of Technology, England) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 13-1-1 to 13-1-6. Research supported by Ministry of Defence Procurement Executive of England. refs

Consideration is given to calculations which contrast the performance of eddy viscosity and second moment closure turbulence models for confined flows dominated by jet-on-jet impingement. Flow configurations relevant to gas-turbine and ramjet side-dump combustors are chosen, with emphasis placed on 2D systems, one plane and one axisymmetric, to allow sufficiently fine meshes to avoid numerical errors. The particular second closure adopted is the Gibson-Lauder Reynold stress transport model, using two alternative sets of constants in the pressure-strain model. For the axisymmetric case, the second moment closure performs significantly better than the eddy viscosity model; improved predictions are obtained for both the strength of recirculation upstream of impingement and the rate of recovery of the downstream velocity profiles. Large-scale period oscillations which are not well modeled by any long-time-average closure are also found. C.A.B.

A92-40103

MEASUREMENTS AND SIMULATION OF THE FLOW AROUND A POPPET VALVE

Z. LILEK (Erlangen-Nuernberg, Universitaet, Erlangen, Federal Republic of Germany), S. NADARAJAH (King's College, London, England), M. PERIC (Erlangen-Nuernberg, Universitaet, Erlangen, Federal Republic of Germany), M. J. TINDAL, and M. YIANNESKIS (King's College, London, England) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 1. University Park, PA, Pennsylvania State University, 1991, p. 13-2-1 to 13-2-6. refs (Contract DFG-PE-350-2/2)

The flow through an axisymmetric inlet port was investigated experimentally and numerically. Laser-Doppler anemometry was used to measure the three ensemble-averaged mean and rms velocity components for two valve lifts, 6 and 10 mm. Numerical calculations of the flows were carried out using a finite volume multigrid method and a standard k-epsilon turbulence model. Comparison of the predictions with the experimental results shows good agreement for the mean velocities for the 10 mm lift case. However, for the 6 mm liftcase the predicted flow differs substantially from the experimental results. This indicates the extreme sensitivity of the flow to the valve lift and the need for more sophisticated turbulence modeling when predicting such flows. Author

A92-40132

DIRECT SIMULATION OF A SUPERSONIC REACTING MIXING-LAYER

O. H. PLANCHE and W. C. REYNOLDS (Stanford University, CA)
IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 21-1-1 to 21-1-5. Research supported by USAF. refs

An important aspect of supersonic combustion is the proper mixing of fuel and oxidizer. In the present work, temporal direct numerical simulations of the reacting compressible shear layer are presented. Although the Reynolds number is low, the general flow structures found are characteristic of what would be found for the large scale structures of high Reynolds number turbulent reacting compressible mixing layers. Results indicate that with heat release and at large Mach numbers, the mixing of fuel and oxidizer by large-scale engulfment of fluid from both sides is not likely to occur. Instead, fluid from each of the free streams is first mixed with product and then diffuses to the reaction zone. Author

A92-40148

STRUCTURAL FEATURES OF A HEATED ROUND TURBULENT JET IN A CROSS-FLOW

Z. HUANG, M. S. LOW, J. G. KAWALL, and J. F. KEFFER (Toronto, University, Canada) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 25-1-1 to 25-1-6. refs
(Contract NSERC-A-2746)

The evolution of a heated round air jet injected into a cross-flow from an elevated source in the form of a circular tube has been investigated experimentally. It is found that a counter-rotating pair of vortices is generated at a downstream location corresponding to approximately one initial jet diameter from the source and that quasi-periodic Karman-like coherent structures occur in the wake of the jet. Moreover, the results suggest that the vorticity associated with the wake structures originates in the boundary layer vorticity within the tube. Author

A92-40172

SIMULATION OF TURBULENT VELOCITY PROFILES APPEARING ON ROTATING AND STATIONARY PARTS OF SUBSONIC COMPRESSORS AND TURBINES

J. K. KALDELLIS (Piraeus, University, Athens, Greece) IN: Symposium on Turbulent Shear Flows, 8th, Munich, Federal Republic of Germany, Sept. 9-11, 1991, Proceedings. Vol. 2. University Park, PA, Pennsylvania State University, 1991, p. 1-6-1, 1-6-2. refs

The successful analysis of the viscous flowfield through any type of turbomachine is based on the use of a closed analytical formulation in the primary direction. An extended and improved form of the classical turbulent shear layer theory is developed to take into account the complex flow pattern through rotating and stationary parts of real turbomachines. The resulting model is successfully applied for a large variety of subsonic compressors and turbines. Author

A92-40189

BEAM SCANNING ERROR OF PHASED ARRAY ANTENNA

SHINGO OHMORI, SHINICHI TAIRA, and MICHAEL AUSTIN (Royal Melbourne Institute of Technology, Australia) Communications Research Laboratory, Journal (ISSN 0914-9260), vol. 38, no. 2, July 1992, p. 217-222. refs
Copyright

Beam scanning error of a phased array antenna between transmitting and receiving frequencies was measured by in-flight experiments using a geostationary satellite. The beam scanning error was found to depend on beam scanning angle and the ratio of transmitting and receiving frequencies. Measured results agreed well with a theoretical prediction. An effective method to eliminate the scanning error is proposed. Author

A92-40400

SHOT PEENING - THEORY AND APPLICATIONS

JOHN S. ECKERSEY, ED. (Metal Improvement Co., Belleville, MI) and JACK CHAMPAIGNE, ED. (Electronics, Inc., Mishawaka, IN) Gournay-sur-Marne, France, IITT-International, 1991, 275 p. No individual items are abstracted in this volume.
(ISBN 2-907669-18-4) Copyright

The papers presented in this volume address a variety of topics that further establish controlled shot peening as an important manufacturing process capable of reproducible results. Topics discussed include shot peening and fatigue, measurement of residual stresses, control of shot peening process, shot peening technology, and applications. Papers are presented on the influence of shot peening on material properties and the controlled shot peening of turbine blades; shot blasting systems; and application of rotary peening in aircraft maintenance. V.L.

A92-40869

OPTIMUM DIMENSIONS OF CONVECTIVE-RADIATIVE SPINES USING A TEMPERATURE CORRELATED PROFILE

A. RAZANI and H. ZOHOOR (New Mexico, University, Albuquerque) Franklin Institute, Journal (ISSN 0016-0032), vol. 328, no. 4, 1991, p. 471-486. refs
Copyright

Optimization of convective-radiative spines with an arbitrary profile is discussed. The profile is assumed to be correlated to the temperature distribution in the spine. Various profiles are considered by introducing a free parameter. With this choice of profile, the nonlinear heat transfer equation is integrated analytically. The optimization problem is written in terms of an integral that can be evaluated numerically. The temperature at the tip of the spine becomes an important optimization parameter in this analysis. The method is well suited for parametric studies and design analysis of optimum spines including temperature dependence of thermophysical properties. Author

A92-40882

INSPECTION OF COMPOSITE STRUCTURES

Aerospace Engineering (ISSN 0736-2536), vol. 12, no. 5, May 1992, p. 9-13.
Copyright

A review is presented of the inherent characteristics of composite materials and the complex equipment and inspection techniques employed to detect the defects and flaws which occur during fabrication of composites, or during their service life. Attention is given to NDI/NDT methods, tap testing, dye penetrants, the isopropyl alcohol evaporative technique, acoustic emission, thermography, thermochromic and thermoluminescent coatings, laser shearography, radiography, ultrasonic inspection, and acoustical and optical holography. R.E.P.

A92-40898

MODERN AERODYNAMIC FLUTTER ANALYSIS

MARTIN HOLLMANN Monterey, CA, Aircraft Designs, Inc., 1991, 138 p. refs
Copyright

A flutter analysis procedure is described which has been implemented on a 386-PC computer using a code called Subsonic Aerodynamic Flutter (SAF). In particular, finite element analysis, verification of the finite element model, preparing input data for SAF, and flutter analysis using SAF are discussed with reference to specific examples. These include the Lancir IV wing, the Golan wing, and fuselage and tail. Some theoretical aspects of flutter analysis are considered, including modal interpolation, generalized aerodynamic force interpolation, and vibration analysis. V.L.

N92-24095*# International Maritime Satellite Organization, London (England). Aeronautical Services Div.

AERONAUTICAL SATELLITE SYSTEM TEST AND IMPLEMENTATION Abstract Only

KEITH SMITH In JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p

149 1990

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

This contribution reports on various aspects of the test and implementation of the new worldwide aeronautical satellite system. The system will be implemented in 1990 following several years of system design and equipment development. The full range of services and equipment will not be available immediately, but rather there will be a progressive phase-in over the first two years of service. Data services using low gain aircraft antennas are planned to be introduced first. Voice service, requiring high gain antennas is expected to begin on a full scale basis about May/June 1990. This contribution explains Inmarsat's approach to testing and authorization of equipment intended to make use of its satellites in this evolving situation. The approach is designed to permit progressive implementation of services while avoiding the need for large scale retrofitting of equipment which has already been introduced into service.

Author

N92-24096*# Canadian Marconi Co. Ltd., Kanata (Ontario).

A HIGH GAIN ANTENNA SYSTEM FOR AIRBORNE SATELLITE COMMUNICATION APPLICATIONS

M. MARITAN and M. BORGFORD *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 150-155 1990

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A high gain antenna for commercial aviation satellites communication is discussed. Electromagnetic and practical design considerations as well as candidate systems implementation are presented. An evaluation of these implementation schemes is given, resulting in the selection of a simple top mounted aerodynamic phased array antenna with a remotely located beam steering unit. This concept has been developed into a popular product known as the Canadian Marconi Company CMA-2100. A description of the technical details is followed by a summary of results from the first production antennas.

Author

N92-24097*# Boeing Commercial Airplane Co., Seattle, WA.

FLIGHT TEST OF ARINC 741 CONFIGURATION LOW GAIN SATCOM SYSTEM ON BOEING 747-400 AIRCRAFT

TIMOTHY A. MURPHY and BRIAN P. STAPLETON *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 157-162 1990

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The Boeing company conducted a flight test of a SATCOM system similar to the ARINC 741 configuration on a production model 747-400. A flight plan was specifically designed to test the system over a wide variety of satellite elevations and aircraft attitudes as well as over land and sea. Interface bit errors, signal quality and aircraft position and navigational inputs were all recorded as a function of time. Special aircraft maneuvers were performed to demonstrate the potential for shadowing by aircraft structures. Both a compass rose test and the flight test indicated that shadowing from the tail is insignificant for the 747-400. However, satellite elevation angles below the aircraft horizon during banking maneuvers were shown to have a significant deleterious effect on SATCOM communications.

Author

N92-24098*# International Maritime Satellite Organization, London (England).

INMARSAT AERONAUTICAL MOBILE SATELLITE SYSTEM: INTERNETWORKING ISSUES

JAY R. SENGUPTA *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 163-168 1990

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The Inmarsat Aeronautical Mobile Satellite System (AMSS) provides air-ground and air-air communications services to aero-mobile users on a global basis. Communicating parties may be connected either directly, or more commonly, via interconnecting networks to the Inmarsat AMSS, in order to construct end-to-end communications circuits. The aircraft earth station (AES) and the aeronautical ground earth station (GES) are the points of interconnection of the Inmarsat AMSS to users, as well as to

interconnecting networks. This paper reviews the internetworking aspects of the Inmarsat AMSS, by introducing the Inmarsat AMSS network architecture and services concepts and then discussing the internetwork address/numbering and routing techniques.

Author

N92-24099*# Canadian Astronautics Ltd., Ottawa (Ontario).
LOW COST, ELECTRONICALLY STEERED PHASED ARRAY FOR GENERAL AVIATION

PETER C. STRICKLAND *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 169-171 1990

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

This paper describes a multifaced, phased array antenna developed for general aviation satellite communications applications. The antenna design satisfies all INMARSAT Aeronautical SDM requirements. Unique features of this antenna include an integral LNA and diplexer, integral phase shifters which are shared among the array faces, a serial beam steering interface and low manufacturing cost.

Author

N92-24163*# Federal Aviation Administration, Washington, DC.
SYSTEM CONSIDERATIONS, PROJECTED REQUIREMENTS AND APPLICATIONS FOR AERONAUTICAL MOBILE SATELLITE COMMUNICATIONS FOR AIR TRAFFIC SERVICES

Abstract Only

K. D. MCDONALD, C. M. MILLER, W. C. SCALES, and D. K. DEMENT *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 569 1990

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The projected application and requirements in the near term (to 1995) and far term (to 2010) for aeronautical mobile services supporting air traffic control operations are addressed. The implications of these requirements on spectrum needs, and the resulting effects on the satellite design and operation are discussed. The U.S. is working with international standards and regulatory organizations to develop the necessary aviation standards, signalling protocols, and implementation methods. In the provision of aeronautical safety services, a number of critical issues were identified, including system reliability and availability, access time, channel restoration time, interoperability, pre-emption techniques, and the system network interfaces. Means for accomplishing these critical services in the aeronautical mobile satellite service (AMSS), and the various activities relating to the future provision of aeronautical safety services are addressed.

Author

N92-24164*# Transport Canada Aviation, Ottawa (Ontario).
AERONAUTICAL MOBILE SATELLITE SERVICE: AIR TRAFFIC CONTROL APPLICATIONS

DAVE SIM *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 570-574 1990

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Canada's history both in aviation and in satellite communications development spans several decades. The introduction of aeronautical mobile satellite communications will serve our requirements for airspace management in areas not served by line-of-sight radio and radar facilities. The ensuing improvements in air safety and operating efficiency are eagerly awaited by the aviation community.

Author

N92-24165*# Anderson Associates, Glenville, NY.
SPECTRUM SHARING BETWEEN AMSS(R) AND MSS

ROY E. ANDERSON *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 575-578 1990

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Generic satellite systems will serve aeronautical, land, and maritime users in the US and Canada. One important service, the Aeronautical Mobile Satellite (Route) Service (AMS(R)S), pertains to the safety and regularity of flight. The North American systems are designed to assure that this vital safety service is not impaired

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in any way as it shares the spectrum and satellites with a large number and great variety of other users in other services. Two of the topics discussed are AMS(R)S requirements and AMS(R)S operation through American Mobile Satellite Corporation (AMSC) Satellites. Author

N92-24167*# International Maritime Satellite Organization, London (England).

FUTURE DEVELOPMENTS IN AERONAUTICAL SATELLITE COMMUNICATIONS

PETER WOOD /in JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p 587-592 1990

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Very shortly aeronautical satellite communications will be introduced on a world wide basis. By the end of the year, voice communications (both to the cabin and cockpit) and packet data communications will be available to both airlines and executive aircraft. During the decade following the introduction of the system, there will be many enhancements and developments which will increase the range of applications, expand the potential number of users, and reduce costs. A number of ways in which the system is expected to evolve over this period are presented. Among the issues which are covered are the impact of spot beam satellites, spectrum and power conservation techniques, and the expanding range of user services. Author

N92-24194*# Canadian Astronautics Ltd., Ottawa (Ontario).

AN AIRCRAFT EARTH STATION FOR GENERAL AVIATION

R. MATYAS, J. BOUGHTON, R. LYONS, S. SPENLER, and J. RIGLEY (Communications Research Centre, Ottawa, Ontario) /in JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) p A3-A8 1990

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

While the focus has been international commercial air traffic, an opportunity exists to provide satellite communications to smaller aircraft. For these users equipment cost and weight critically impact the decision to install satellite communications equipment. Less apparent to the operator is the need for a system infrastructure that will be supported both regionally and internationally and that is compatible with the ground segment being installed for commercial aeronautical satellite communications. A system concept is described as well as a low cost terminal that are intended to satisfy the small aircraft market. Author

N92-24242*# Rockwell International Science Center, Thousand Oaks, CA.

A USER GUIDE FOR THE EMTAC-MZ CFD CODE Final Report

KUO-YEN SZEMA and SUKUMAR R. CHAKRAVARTHY May 1990 64 p

(Contract NAS1-17492; RTOP 505-60-01-02)

(NASA-CR-4283; NAS 1.26:4283) Avail: NTIS HC/MF A04 CSCL 20D

The computer code (EMTAC-MZ) was applied to investigate the flow field over a variety of very complex three-dimensional (3-D) configurations across the Mach number range (subsonic, transonic, supersonic, and hypersonic flow). In the code, a finite volume, multizone implementation of high accuracy, total variation diminishing (TVD) formulation (based on Roe's scheme) is used to solve the unsteady Euler equations. In the supersonic regions of the flow, an infinitely large time step and a space-marching scheme is employed. A finite time step and a relaxation or 3-D approximate factorization method is used in subsonic flow regions. The multizone technique allows very complicated configurations to be modeled without geometry modifications, and can easily handle combined internal and external flow problems. An elliptic grid generation package is built into the EMTAC-MZ code. To generate the computational grid, only the surface geometry data are required. Results obtained for a variety of configurations, such as fighter-like configurations (F-14, AVSTOL), flow through inlet, multi-bodies (shuttle with external tank and SRBs), are reported and shown to be in good agreement with available experimental data. Author

N92-24344*# High Technology Corp., Hampton, VA.

A THREE-DIMENSIONAL, COMPRESSIBLE, LAMINAR BOUNDARY-LAYER METHOD FOR GENERAL FUSELAGES.

VOLUME 2: USER'S MANUAL Final Report

YONG-SUN WIE May 1990 166 p

(Contract NAS1-18240; RTOP 505-60-31)

(NASA-CR-4292-VOL-2; NAS 1.26:4292-VOL-2) Avail: NTIS HC/MF A08 CSCL 20D

This user's manual contains a complete description of the computer programs developed to calculate three-dimensional, compressible, laminar boundary layers for perfect gas flow on general fuselage shapes. These programs include the 3-D boundary layer program (3DBLC), the body-oriented coordinate program (BCC), and the streamline coordinate program (SCC). Subroutine description, input, output and sample case are discussed. The complete FORTRAN listings of the computer programs are given. Author

N92-24345*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.

PREDICTION OF RESPONSE OF AIRCRAFT PANELS

SUBJECTED TO ACOUSTIC AND THERMAL LOADS Final Report, Dec. 1987 - Mar. 1992

CHUH MEI May 1992 49 p

(Contract NAG1-838)

(NASA-CR-190305; NAS 1.26:190305) Avail: NTIS HC/MF A03 CSCL 20K

The primary effort of this research project has been focused on the development of analytical methods for the prediction of random response of structural panels subjected to combined and intense acoustic and thermal loads. The accomplishments on various acoustic fatigue research activities are described first, then followed by publications and theses. Topics covered include: transverse shear deformation; finite element models of vibrating composite laminates; large deflection vibration modeling; finite element analysis of thermal buckling; and prediction of three dimensional duct using boundary element method. H.A.

N92-24514*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

WORKSHOP ON ENGINEERING TURBULENCE MODELING

LOUIS A. POVINELLI, ed., W. W. LIU, ed., A. SHABBAR, ed., and T.-H. SHIH, ed. Mar. 1992 510 p Workshop held in Cleveland, OH, 21-22 Aug. 1991

(Contract NASA ORDER C-99066-G)

(NASA-CP-10088; E-6830; ICOMP-92-02; CMOTT-92-02; NAS 1.55:10088) Avail: NTIS HC/MF A22 CSCL 20D

Discussed here is the future direction of various levels of engineering turbulence modeling related to computational fluid dynamics (CFD) computations for propulsion. For each level of computation, there are a few turbulence models which represent the state-of-the-art for that level. However, it is important to know their capabilities as well as their deficiencies in order to help engineers select and implement the appropriate models in their real world engineering calculations. This will also help turbulence modelers perceive the future directions for improving turbulence models. The focus is on one-point closure models (i.e., from algebraic models to higher order moment closure schemes and partial differential equation methods) which can be applied to CFD computations. However, other schemes helpful in developing one-point closure models, are also discussed.

N92-24531*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.

SOME COMMENTS ON TURBULENCE MODELING FROM AN INDUSTRIAL PERSPECTIVE

MUNIR M. SINDIR /in NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling p 351-358 Mar. 1992

Avail: NTIS HC/MF A22 CSCL 20D

In propulsion industry, computational techniques (namely computational fluid dynamics) are gradually becoming engineering design and analysis tools, especially in the case of high performance aircraft engines, high speed air breathing propulsion,

rocket propulsion, and advanced nuclear propulsion and electric propulsion. The key issues in acceptance of CFD are turn around time, cost, and accuracy. The turn around time of analysis has to fit program schedules. Cost is still the bottom line, the value of CFD to the program should at least balance its cost. CFD can be used if it can be divided into two major parts: numerics and physical models. Author

N92-24547* High Technology Corp., Hampton, VA.
**A THREE-DIMENSIONAL, COMPRESSIBLE, LAMINAR
 BOUNDARY-LAYER METHOD FOR GENERAL FUSELAGES.**
VOLUME 1: NUMERICAL METHOD Final Report

YONG-SUN WIE May 1990 117 p
 (Contract NAS1-18240; RTOP 505-60-31)
 (NASA-CR-4292-VOL-1; NAS 1.26:4292-VOL-1) Avail: NTIS
 HC/MF A06 CSCL 20D

A procedure for calculating 3-D, compressible laminar boundary layer flow on general fuselage shapes is described. The boundary layer solutions can be obtained in either nonorthogonal 'body oriented' coordinates or orthogonal streamline coordinates. The numerical procedure is 'second order' accurate, efficient and independent of the cross flow velocity direction. Numerical results are presented for several test cases, including a sharp cone, an ellipsoid of revolution, and a general aircraft fuselage at angle of attack. Comparisons are made between numerical results obtained using nonorthogonal curvilinear 'body oriented' coordinates and streamline coordinates. Author

N92-24797*# National Aeronautics and Space Administration.
 Langley Research Center, Hampton, VA.

**A SIMPLIFIED METHOD FOR THERMAL ANALYSIS OF A
 COWL LEADING EDGE SUBJECT TO INTENSE LOCAL
 SHOCK-WAVE-INTERFERENCE HEATING**

DAVID M. MCGOWAN, CHARLES J. CAMARDA, and STEPHEN
 J. SCOTT Washington Mar. 1992 40 p
 (Contract RTOP 506-43-31-04)
 (NASA-TP-3167; L-16505; NAS 1.60:3167) Avail: NTIS HC/MF
 A03 CSCL 20D

Type IV shock wave interference heating on a blunt body causes extremely intense heating over a very localized region of the body. An analytical solution is presented to a heat transfer problem that approximates the shock wave interference heating of an engine cowl leading edge of the National Aero-Space Plane. The problem uses a simplified geometry to represent the leading edge. An analytical solution is developed that provides a means for approximating maximum temperature differences between the outer and inner surface temperatures of the leading edge. The solution is computationally efficient and, as a result, is well suited for conceptual and preliminary design or trade studies. Transient and steady state analyses are conducted, and results obtained from the analytical solution are compared with results of 2-D thermal finite element analyses over a wide range of design parameters. Isotropic materials as well as laminated composite materials are studied. Results of parametric studies are presented to indicate the effects of the thickness of the cowl leading edge and the width of the region heated by the shock wave interference on the thermal response of the leading edge. Author

N92-24873# Defence Research Establishment Suffield, Ralston
 (Alberta).

**BOUNDARY LAYER COMPUTATIONS USING A GENERALIZED
 FORMULATION**

D. BERGERON and D. W. ZINGG In CASI, Proceedings of the
 3rd Canadian Symposium on Aerodynamics p 365-378 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St.
 W., Suite 601, Ottawa, ON K2P 0J1 Canada

A numerical solution procedure for a generalized form of the boundary-layer equations based on the formulation of Steger and Van Dalsem is described. The formulation, which is intended for use in a fortified Navier-Stokes procedure, uses the boundary-layer equations expressed in body-conformal coordinates but transformed into generalized coordinates for the solution process. Results are presented for attached and separated transonic airfoil

flows with external pressure gradient given from a Navier-Stokes solution in the boundary layers. Discrepancies are noted near shocks and trailing edges, where normal pressure gradients can be appreciable and streamwise velocity gradients can be high.

Author (CISTI)

N92-24874# Canadian Forces Headquarters, Ottawa (Ontario).
**THE EFFECT OF DROPLET SIZING UNCERTAINTY ON ICE
 ACCRETIONS**

ROBERT G. FOSTER and C. SCOTT BARTLETT (Arnold
 Engineering Development Center, Arnold Air Force Station, TN.)
 In CASI, Proceedings of the 3rd Canadian Symposium on
 Aerodynamics p 379-391 1991
 Avail: Canadian Aeronautics and Space Inst., 222 Somerset St.
 W., Suite 601, Ottawa, ON K2P 0J1 Canada

Data to evaluate the safe operational limits of aircraft and propulsion systems in icing environments can be obtained during ground testing. A concern in the conduct of these tests is how closely the icing test parameters must be known and how the uncertainties in these parameters affect the icing test results. In this paper, experimental droplet sizing data uncertainties are discussed and relative bias errors as large as 15 microns in mass median diameter measured by different droplet sizing instruments are identified. Experimental and analytical results are presented to illustrate the sources and magnitude of droplet sizing bias errors. Ice accretion test results of a NACA 0012 airfoil at low speed were used to illustrate the impact of these errors. Droplet sizing instrumentation comparison tests have demonstrated large bias errors between instrument measurements. Droplet sizing instrument accuracy is dependent on many factors including the particular test conditions being measured. The impact droplet sizing errors on ice accretion test results is dependent on the particular test conditions. Ice accretion shape predictions made with the LEWICE model show a strong sensitivity to droplet size, thus agreeing with the experimental data trends. The influence of droplet size variations on predicted ice shapes is sometimes different than the influence on the experimentally accreted ice shapes. Parametric studies such as those conducted for ice accretion shape changes caused by droplet size variations offer a means to understand sensitivity of test results to experimental uncertainty and can help guide refinements in mathematical models. Author (CISTI)

N92-24892# Oak Ridge National Lab., TN.
**ADVANCED TECHNIQUES IN CURRENT SIGNATURE
 ANALYSIS**

S. F. SMITH and K. N. CASTLEBERRY 1992 14 p Presented
 at the 46th Meeting of the Mechanical Failures Prevention Group,
 Virginia Beach, VA, 7-9 Apr. 1992
 (Contract DE-AC05-84OR-21400)
 (DE92-007680; CONF-920474-2) Avail: NTIS HC/MF A03

In general, both ac and dc motors can be characterized as weakly nonlinear systems, in which both linear and nonlinear effects occur simultaneously. Fortunately, the nonlinearities are generally well behaved and understood and can be handled via several standard mathematical techniques already well developed in the systems modeling area; examples are piecewise linear approximations and Volterra series representations. Field measurements of numerous motors and motor-driven systems confirm the rather complex nature of motor current spectra and illustrate both linear and nonlinear effects (including line harmonics and modulation components). Although previous current signature analysis (CSA) work at Oak Ridge and other sites has principally focused on the modulation mechanisms and detection methods (AM, PM, and FM), more recent studies have been conducted on linear spectral components (those appearing in the electric current at their actual frequencies and not as modulation sidebands). For example, large axial-flow compressors (approximately 3300 hp) in the US gaseous diffusion uranium enrichment plants exhibit running-speed (approximately 20 Hz) and high-frequency vibrational information (greater than 1 kHz) in their motor current spectra. Several signal-processing techniques developed to facilitate analysis of these components, including specialized filtering schemes, are presented. Finally, concepts for the designs of

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advanced digitally based CSA units are offered, which should serve to foster the development of much more computationally capable 'smart' CSA instrumentation in the next several years. DOE

N92-24959* # National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

DESCRIPTION OF A PRESSURE MEASUREMENT TECHNIQUE FOR OBTAINING SURFACE STATIC PRESSURES OF A RADIAL TURBINE

L. DANIELLE DICICCO, BRENT C. NOWLIN, and LIZET TIRRES (Sverdrup Technology, Inc., Brook Park, OH.) 1992 11 p Proposed for presentation at the 17th Aerospace Ground Testing Conference, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA (Contract RTOP 535-05-10) (NASA-TM-105643; E-6989; NAS 1.15:105643; AIAA PAPER 92-4006) Avail: NTIS HC/MF A03 CSCL 14/2

The aerodynamic performance of a solid uncooled version of a cooled radial turbine was evaluated in the Small Engine Components Test Facility Turbine rig at the NASA Lewis Research Center. Specifically, an experiment was conducted to rotor surface static pressures. This was the first time surface static pressures had been measured on a radial turbine at NASA Lewis. These pressures were measured by a modified Rotating Data Package (RDP), a standard product manufactured by Scanivalve, Inc. Described here are the RDP, and the modifications that were made, as well as the checkout, installation, and testing procedures. The data presented are compared to analytical results obtained from NASA's MERIDL TSONIC BLAYER (MTSB) code. Author

N92-24984* # National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ADVANCED ROTORCRAFT TRANSMISSION (ART) PROGRAM SUMMARY

T. L. KRANTZ and J. G. KISH (Sikorsky Aircraft, Stratford, CT.) 1992 14 p Presented at the 28th Joint Propulsion Conference, Nashville, TN, 6-8 Jul. 1992; sponsored in part by AIAA, SAE, ASME, and ASEE (Contract DA PROJ. 1L1-62211-A-47-A; RTOP 505-63-36) (NASA-TM-105665; E-7027; AVSCOM-TR-92-C-011; NAS 1.15:105665; AIAA PAPER 92-3365) Avail: NTIS HC/MF A03 CSCL 13/9

The Advanced Rotorcraft Transmission (ART) Program was initiated to advance the state of the art for rotorcraft transmissions. The goal of the ART Program was to develop and demonstrate the technologies needed to reduce transmission weight by 25 pct. and reduce noise by 10 dB while obtaining a 5000 hr 'mean time between failure'. The research done under the ART Program is summarized. A split path design was selected as best able to meet the program goals. Key part technologies needed for this design were identified, studied, and developed. Two of these technologies are discussed in detail: the load sharing of split path designs including the use of a compliant elastomeric torque splitter and the application of a high ratio, low pitch line velocity gear mesh. Development of an angular contact spherical roller bearing, transmission error analysis, and fretting fatigue testing are discussed. The technologies for a light weight, quiet, and reliable rotorcraft transmission were demonstrated. Author

N92-25054# Kumm (Emerson L.), Tempe, AZ.

FLAT BELT CONTINUOUSLY VARIABLE HIGH SPEED DRIVE EMERSON L. KUMM Feb. 1992 53 p

(Contract DE-FG01-90CE-15470)

(DE92-008952; DOE/CE-15470/T7) Avail: NTIS HC/MF A04
A study was undertaken at Kumm Industries funded by DOE in the NBS/DOE Energy-Related Inventions Program starting in August 1990 to design, construct and test a novel very high speed flat belt drive. The test arrangement consists of a multiple belt-pulley configuration that transmits power from a low speed (2000-4000 RPM) input to a small pulley 'turbine' (27,000 to 55,000 RPM) and then to the low speed output variable radius pulley (2000-5000 RPM) via a special self-active tensioner. Transmitting 25 HP to and from the 'turbine' corresponds to obtaining 50 HP in one direction only in a possible turbo compounded engine

application. The high speed of the 'turbine' belts, i.e. 100 meters/sec at 55,000 RPM, while transferring substantial power is a new much higher operating regime for belts. The study showed that the available belts gave overall test rig efficiencies somewhat above 80 percent for the higher speeds (50,000 RPM) and higher powers (corresponding to above 90 percent in the turbocompound application) and significantly better efficiencies at slightly lower speeds. The tests revealed a number of improved approaches in the design of such high speed drives. It appears that there is considerable possibility for further improvement and application of such equipment. DOE

N92-25137* # National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

RADAR MULTIPATH STUDY FOR RAIN-ON-RADOME EXPERIMENTS AT THE AIRCRAFT LANDING DYNAMICS FACILITY

ANNE I. MACKENZIE and LEO D. STATON May 1990 42 p (Contract RTOP 505-66-11-07) (NASA-TM-101657; NAS 1.15:101657) Avail: NTIS HC/MF A03 CSCL 20/14

An analytical study to determine the feasibility of a rain-on-radome experiment at the Aircraft Landing Dynamics Facility (ALDF) at the Langley Research Center is described. The experiment would measure the effects of heavy rain on the transmission of X-band weather radar signals, looking in particular for sources of anomalous attenuation. Feasibility is determined with regard to multipath signals arising from the major structural components of the ALDF. A computer program simulates the transmit and receive antennas, direct-path and multipath signals, and expected attenuation by rain. In the simulation, antenna height, signal polarization, and rainfall rate are variable parameters. The study shows that the rain-on-radome experiment is feasible with regard to multipath signals. The total received signal, taking into account multipath effects, could be measured by commercially available equipment. The study also shows that horizontally polarized signals would produce better experimental results than vertically polarized signals. Author

N92-25267* # National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

THE NASA/INDUSTRY DESIGN ANALYSIS METHODS FOR VIBRATIONS (DAMVIBS) PROGRAM: A GOVERNMENT OVERVIEW

RAYMOND G. KVATERNIK Apr. 1992 12 p Presented at the 33rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Dallas, TX, 13-15 Apr. 1992 (Contract RTOP 505-63-36-01) (NASA-TM-107579; NAS 1.15:107579) Avail: NTIS HC/MF A03

LaRC, under the Design Analysis Methods for Vibrations (DAMVIBS) Program, set out in 1984 to establish the technology base needed by the rotorcraft industry for developing an advanced finite-element-based dynamics design analysis capability for vibrations. Considerable work was performed by the industry participants in the program since that time. Because the DAMVIBS Program is being phased out, a government/industry assessment of the program was made to identify those accomplishments and contributions which may be ascribed to the program. The purpose is to provide an overview of the program and its accomplishments and contributions from the perspective of the government sponsoring organization. Author

N92-25342# National Aerospace Lab., Tokyo (Japan).

TURBINE DRIVE SYSTEM OF THE HIGH PRESSURE LOX TURBOPUMP TEST FACILITY

Y. WATANABE, S. HASEGAWA, K. KAMIJO, R. HASHIMOTO, Y. SAKAMOTO, and S. TONE Jan. 1991 17 p In JAPANESE; ENGLISH summary (DE92-783191; NAL-TM-631) Avail: NTIS HC/MF A03

This paper describes the turbine drive system of facilities such as a gas generator among high pressure liquid oxygen (LOX) turbopump test facilities, which were constructed for the rating test of a high pressure LOX turbopump. In particular, the control

sequence of the high pressure gaseous hydrogen/liquid oxygen gas generator and the turbine exhaust gas disposal unit for high pressures and large flows are explained in detail. The gas generator requires a large amount of propellant. Therefore control valves or remote control valves, which can accurately control and supply large and small amounts of propellant, are needed. As a result, a programmable sequencer was developed in order to control the opening and closing of every valve. Moreover, as a solution to the problem of aerodynamic noise and oscillation, a method to install a pressure reducing unit in the exhaust gas disposal system was applied. As a result, it was possible to discharge a large quantity of high temperature and high pressure combustion gas with excess hydrogen after driving the turbine without excessive noise and oscillation. DOE

N92-25376* Analytical Services and Materials, Inc., Hampton, VA.

A COMPRESSIBLE NAVIER-STOKES SOLVER WITH TWO-EQUATION AND REYNOLDS STRESS TURBULENCE CLOSURE MODELS Final Report

JOSEPH H. MORRISON Washington NASA May 1992 44 p

(Contract NAS1-19320; RTOP 505-59-50-01)

(NASA-CR-4440; NAS 1.26:4440) Avail: NTIS HC/MF A03

This report outlines the development of a general purpose aerodynamic solver for compressible turbulent flows. Turbulent closure is achieved using either two equation or Reynolds stress transportation equations. The applicable equation set consists of Favre-averaged conservation equations for the mass, momentum and total energy, and transport equations for the turbulent stresses and turbulent dissipation rate. In order to develop a scheme with good shock capturing capabilities, good accuracy and general geometric capabilities, a multi-block cell centered finite volume approach is used. Viscous fluxes are discretized using a finite volume representation of a central difference operator and the source terms are treated as an integral over the control volume. The methodology is validated by testing the algorithm on both two and three dimensional flows. Both the two equation and Reynolds stress models are used on a two dimensional 10 degree compression ramp at Mach 3, and the two equation model is used on the three dimensional flow over a cone at angle of attack at Mach 3.5. With the development of this algorithm, it is now possible to compute complex, compressible high speed flow fields using both two equation and Reynolds stress turbulent closure models, with the capability of eventually evaluating their predictive performance. Author

N92-25403# National Aerospace Lab., Tokyo (Japan). DEVELOPMENT OF PRE- AND POST-PROCESSOR SYSTEM FOR STRUCTURAL ANALYSIS [KOZO KAISEKI YO PURI/POSUTO PUROSESSA SHISUTEMU NO KAIHATSU NI TSUITE]

HIDEHITO OKUMURA, KUNIHICO OOTAKE, SHINICHI MINEO, OSAMU MOCHIZUKI, KUNIHICO KOJIMA, and KENJI SHINOHARA Oct. 1990 20 p In JAPANESE Original contains color illustrations

(NAL-TM-628; ISSN-0452-2982; JTN-92-80315) Avail: NTIS HC/MF A03

A new CAE (Computer Aided Engineering) system for use in the design and analysis of aerospace technology was developed at NAL. The central part of the CAE system is general purpose structural analysis programs. The pre-processor consisted mainly from the three dimensional form modeling system and the FEM (Finite Element Method) modeling system. The former systems generate data for the analysis by FEM and converts the generated data to the next programs. And the post-processor system mainly consists of a graphic visualization system of the calculated results. And the integrated pre- and post-processor of CAE system consists of interfaces and communication files for the linkage with related systems. This CAE system is able to perform a series of work from model building to evaluations of results by the use of graphic terminals, and detailed designs of large structure components are possible by the use of this system. The overall designs, functions,

and performances of the pre- and post-processor in the CAE system for structure research and development system are reported. Author (NASDA)

N92-25547 Texas A&M Univ., College Station.

AN EXPERIMENTAL INVESTIGATION OF THE SURFACE FLOW AND WAKE DYNAMICS ASSOCIATED WITH TRANSVERSE FLOW OVER WAVY CYLINDERS Ph.D. Thesis

BYRAM BAYS-MUCHMORE 1991 311 p

Avail: Univ. Microfilms Order No. DA9206461

Fluid flow over wavy and right circular cylinders was investigated experimentally in the TAMU 2' x 3' wind tunnel and 2' x 3' water tunnel. Surface-pressure and three-component laser-Doppler-velocimetry measurements were obtained at a Reynolds number of 20,000 based on mean diameter. Flow-visualization tests were conducted for right circular cylinders at Reynolds numbers from 330 to 21,000 and for wavy cylinders at Reynolds numbers of 5,000, 10,000 and 20,000. These tests revealed new information concerning the secondary streamwise vortical structures (ribs) in the immediate wake of a right circular cylinder. The formation of the ribs was observed to be linked to an interaction between the near-surface flow on the leeward side of the cylinder and each von Karman vortex as it advected from the vortex-formation region. The spanwise spacing of the ribs in the immediate wake was independent of Reynolds number over the range of Reynolds numbers tested. The ribs significantly affected the von Karman vortices at the upstream end of each braid and rapidly distorted stream surfaces as they were entrained into the wake. The wavy-cylinder flow field exhibited streamwise trailing vortices originating at the boundary-layer separation lines near the geometric nodes. The trailing vortices caused the width of the wake to shrink behind the geometric nodes and expand behind the geometric saddles. The behavior of these structures, in response to the von Karman vortex shedding, indicated that pairing of counter-rotating streamwise vortices can be suppressed by the application of an axial strain field. The wavy-cylinder geometry had no significant effect on the spanwise spacing or the spatial locations of the rib structures. Despite large spanwise variations in the vortex-formation region, the velocity and Reynolds shear-stress fields in the wake of a wavy cylinder rapidly approached a state of spanwise uniformity. No significant differences were observed between the wake of a wavy cylinder and that of a right circular cylinder beyond a distance of 4 diameters downstream. The pressure drag coefficient was not significantly different from that for a right circular cylinder. Dissert. Abstr.

N92-25571 Michigan Univ., Ann Arbor.

NEAR-INJECTOR STRUCTURE OF NON-EVAPORATING PRESSURE-ATOMIZED SPRAYS AT VARIOUS AMBIENT DENSITIES Ph.D. Thesis

LI-KENG TSENG 1991 194 p

Avail: Univ. Microfilms Order No. DA9208673

A theoretical and experimental study of the near-injector region of nonevaporating round liquid jets in still gases is described, emphasizing effects of ambient gas densities in the atomization breakup regime where liquid breakup begins right at the jet exit. Injectors (9.5 mm exit diameter) producing fully developed turbulent pipe flow and slug flow exit conditions were considered. The applicability of the locally homogeneous flow (LHF) approximation to predict flow properties in the near-injector region also was evaluated at various ambient densities. It was found that mixing was strongly affected by the gas/liquid density ratio and the degree of flow development at the jet exit, with the largest gas/liquid density ratio and fully developed turbulent pipe flow yielding the fastest mixing rates. The observed structure of the flow supports the classical view of pressure atomized sprays, e.g., an all liquid core surrounded by a multiphase mixing layer. Dispersed phase properties also are influenced by the gas/liquid density ratio and degree of flow development. Drop sizes and velocities decrease as ambient density increases. Primary breakup was affected by aerodynamic effects at large gas/liquid density ratios while the turbulence intensity in the liquid dominates primary breakup at low gas/liquid density ratios in the near-injector region of the flows.

Low liquid volume fractions were found in the multiphase mixing layer suggesting that primary and secondary breakup dominate processes in the mixing layer rather than collisions between smaller drops. Separated flow effects also were evident from large velocity differences between large drops (higher velocities) and small drops (lower velocities), with the velocity differences decreasing as the gas/liquid density ratio increased. Dissert. Abstr.

N92-25589 Old Dominion Univ., Norfolk, VA.
FINITE ELEMENT FREQUENCY DOMAIN SOLUTION OF NONLINEAR PANEL FLUTTER WITH TEMPERATURE EFFECTS AND FATIGUE LIFE ANALYSIS Ph.D. Thesis
 DAVID YONGXIANG XUE 1991 189 p
 Avail: Univ. Microfilms Order No. DA9208330

A frequency domain solution method for nonlinear panel flutter with thermal effects using a consistent finite element formulation has been developed. The von Karman nonlinear 'strain displacement' relation is used to account for large deflections, the quasi-steady first-order piston theory is employed for aerodynamic loading and the quasi-steady thermal stress theory is applied for the thermal stresses with a given change of the temperature distribution, $\Delta T(x, y, z)$. The equation of motion under a combined thermal-aerodynamic loading can be mathematically separated into two equations and then solved in sequence: (1) thermal-aerodynamic postbuckling and (2) limit-cycle oscillation. The Newton-Raphson iteration technique is used to solve the nonlinear algebraic equations and an updated linearized eigensolution procedure is adopted to solve the nonlinear differential equations. The finite element frequency domain solution results are compared with numerical time integration results. Limit-cycle responses, flutter boundaries, snap-through areas and stress distributions are obtained from the present analyses. The effects of different temperature distributions, panel aspect ratios and boundary support conditions are investigated. Dissert. Abstr.

N92-25649* # Detroit Diesel Allison, Indianapolis, IN.
ADVANCED TURBINE TECHNOLOGY APPLICATIONS PROJECT (ATTAP) Final Annual Report, 1990
 Dec. 1991 156 p
 (Contract DEN3-336)
 (NSA-CR-189142; DOE/NASA/0336-3; NAS 1.26:189142; EDR-15593) Avail: NTIS HC/MF A08

ATTAP activities were highlighted by test bed engine design and development activities; ceramic component design; materials and engine component characterization; ceramic component process development and fabrication; component rig testing; and test bed engine fabrication and testing. Specifically, ATTAP aims to develop and demonstrate the technology of structural ceramics that have the potential for competitive automotive engine life cycle cost and for operating for 3500 hours in a turbine engine environment at temperatures up to 1371 C (2500 F). Author

N92-25660* # Indiana Univ.-Purdue Univ., Fort Wayne. Dept. of Engineering.
BOILING AND CONDENSATION IN MICROFIN TUBES
 LYNN M. SCHLAGER In VKI, Industrial Heat Exchangers 28 p 1991
 Copyright Avail: NTIS HC/MF A99

A general overview of microfin tubes and their applications is presented. Manufacturing processes, commercial availability, experimental heat transfer, and pressure drop data for various refrigerants (including alternative refrigerants and refrigerant-oil mixtures), physical mechanisms of enhancement, and the incorporation of microfin tubes in common heat exchanger configurations are discussed. Microfin tubes, also known by various trade names, are characterized by numerous small fins which typically spiral down the inside wall of tubes at angles ranging from 10 to 30 degrees. The number of fins ranges from 48 to 70 with typical fin heights of 0.12 to 0.30 mm (fin height generally less than 3 percent of the inside diameter of the tube). Fin shapes may vary and the inside surface area of microfin tubes is 10 to 70 percent greater than the area of equivalent smooth tubes.

Heat transfer can be enhanced by up to a factor of three with microfin tubes. ESA

N92-25667* # Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
EXPERIMENTAL METHODS TO DETERMINE HEAT EXCHANGER PERFORMANCES
 C. MARVILLET and R. VIDIL In VKI, Industrial Heat Exchangers 35 p 1991
 Copyright Avail: NTIS HC/MF A99

A heat exchanger test platform and experiments carried out thereon are described. The following studies are summarized: determination of the performances of a welded plate evaporator for a refrigeration unit; determination of the performance of a compact heat exchanger for gas turbine heat recovery; and determination of the performance of a fin and tube heat exchanger on diesel engine exhaust gases. ESA

N92-25722* # National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CARTESIAN BASED GRID GENERATION/ADAPTIVE MESH REFINEMENT
 WILLIAM J. COIRIER In its Workshop on Grid Generation and Related Areas p 107-120 Apr. 1992
 Avail: NTIS HC/MF A08

Grid adaptation has recently received attention in the computational fluid dynamics (CFD) community as a means to capture the salient features of a flowfield by either moving grid points of a structured or by adding cells in an unstructured manner. An approach based on a background cartesian mesh is investigated from which the geometry is 'cut' out of the mesh. Once the mesh is obtained, a solution on this coarse grid is found, that indicates which cells need to be refined. This process of refining/solving continues until the flow is grid refined in terms of a user specified global parameter (such as drag coefficient etc.). The advantages of this approach are twofold: the generation of the base grid is independent of the topology of the bodies or surfaces around/through which the flow is to be computed, and the resulting grid (in uncut regions) is highly isotropic, so that the truncation error is low. The flow solver (which, along with the grid generation is still under development) uses a completely unstructured data base, and is a finite volume, upwinding scheme. Current and future work will address generating Navier-Stokes suitable grids by using locally aligned and normal face/cell refining. The attached plot shows a simple grid about two turbine blades. Author

N92-25727* # National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INTEGRATING AERODYNAMIC SURFACE MODELING FOR COMPUTATIONAL FLUID DYNAMICS WITH COMPUTER AIDED STRUCTURAL ANALYSIS, DESIGN, AND MANUFACTURING
 SCOTT A. THORP In its Workshop on Grid Generation and Related Areas p 159-168 Apr. 1992
 Avail: NTIS HC/MF A08

This presentation will discuss the development of a NASA Geometry Exchange Specification for transferring aerodynamic surface geometry between LeRC systems and grid generation software used for computational fluid dynamics research. The proposed specification is based on a subset of the Initial Graphics Exchange Specification (IGES). The presentation will include discussion of how the NASA-IGES standard will accommodate improved computer aided design inspection methods and reverse engineering techniques currently being developed. The presentation is in viewgraph format. Author

N92-25809* # National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DEVELOPMENT OF NEW FLUX SPLITTING SCHEMES
 MENG-SING LIOU and CHRISTOPHER J. STEFFEN, JR. In its Computational Fluid Dynamics p 19-28 Feb. 1992
 Avail: NTIS HC/MF A10; 11 functional color pages
 Maximizing both accuracy and efficiency has been the primary

objective in designing a numerical algorithm for computational fluid dynamics (CFD). This is especially important for solutions of complex three dimensional systems of Navier-Stokes equations which often include turbulence modeling and chemistry effects. Recently, upwind schemes have been well received for their capability in resolving discontinuities. With this in mind, presented are two new flux splitting techniques for upwind differencing. The first method is based on High-Order Polynomial Expansions (HOPE) of the mass flux vector. The second new flux splitting is based on the Advection Upwind Splitting Method (AUSM). The calculation of the hypersonic conical flow demonstrates the accuracy of the splitting in resolving the flow in the presence of strong gradients. A second series of tests involving the two dimensional inviscid flow over a NACA 0012 airfoil demonstrates the ability of the AUSM to resolve the shock discontinuity at transonic speed. A third case calculates a series of supersonic flows over a circular cylinder. Finally, the fourth case deals with tests of a two dimensional shock wave/boundary layer interaction. H.A.

N92-25911*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

COMPUTATIONAL STRUCTURES TECHNOLOGY FOR AIRFRAMES AND PROPULSION SYSTEMS

AHMED K. NOOR, comp., JERROLD M. HOUSNER, comp., JAMES H. STARNES, JR., comp., DALE A. HOPKINS, comp., and CHRISTOS C. CHAMIS, comp. (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) Washington May 1992 516 p Workshops held in Cleveland, OH, 26-27 Jun. 1991 and in Hampton, VA, 4-5 Sep. 1991; sponsored by NASA, Washington and Virginia Univ., Hampton (Contract RTOP 505-63-53-01) (NASA-CP-3142; L-17049; NAS 1.55:3142) Avail: NTIS HC/MF A22

This conference publication contains the presentations and discussions from the joint University of Virginia (UVA)/NASA Workshops. The presentations included NASA Headquarters perspectives on High Speed Civil Transport (HSCT), goals and objectives of the UVA Center for Computational Structures Technology (CST), NASA and Air Force CST activities, CST activities for airframes and propulsion systems in industry, and CST activities at Sandia National Laboratory.

N92-25912*# Virginia Univ., Charlottesville.

COMPUTATIONAL STRUCTURES TECHNOLOGY AND UVA CENTER FOR CST

AHMED K. NOOR *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems p 5-41 May 1992
Avail: NTIS HC/MF A22

Rapid advances in computer hardware have had a profound effect on various engineering and mechanics disciplines, including the materials, structures, and dynamics disciplines. A new technology, computational structures technology (CST), has recently emerged as an insightful blend between material modeling, structural and dynamic analysis and synthesis on the one hand, and other disciplines such as computer science, numerical analysis, and approximation theory, on the other hand. CST is an outgrowth of finite element methods developed over the last three decades. The focus of this presentation is on some aspects of CST which can impact future airframes and propulsion systems, as well as on the newly established University of Virginia (UVA) Center for CST. The background and goals for CST are described along with the motivations for developing CST, and a brief discussion is made on computational material modeling. We look at the future in terms of technical needs, computing environment, and research directions. The newly established UVA Center for CST is described. One of the research projects of the Center is described, and a brief summary of the presentation is given. Author

N92-25914*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

PROGRESS IN INTEGRATED ANALYSIS WITH ADAPTIVE UNSTRUCTURED MESHING

PRAMOTE DECHAUMPHAI *In its* Computational Structures Technology for Airframes and Propulsion Systems p 59-79 May 1992

Avail: NTIS HC/MF A22

Design of lightweight structures and thermal protection systems for hypersonic vehicles depend on accurate prediction of aerothermal loads, structural temperatures and their gradients, and structural deformations and stresses. Concentration is on an alternative meshing technique which generates an entirely new adaptive unstructured mesh based on the solution obtained from the earlier mesh. The technique combined with the finite element method has been shown to significantly improve the efficiency and accuracy of the fluid, thermal, and structural analyses. Current capability of the adaptive unstructured meshing technique for the integrated fluid-thermal-structural analysis is described first. The technique was extended to transient thermal analysis of structures with time-dependent adaptive meshing to capture the detailed temperature response with a minimum number of unknowns and computational cost. Both linear and higher-order finite elements are implemented to demonstrate the generality of the technique and to investigate their solution accuracy. Currently, the adaptive meshing technique is being developed for plane structures that can be modeled with membrane elements and built-up structures modeled with membrane and bending elements. The capability of the technique to these different disciplinary problems is demonstrated by several examples. Author

N92-25915*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A BRIEF OVERVIEW OF COMPUTATIONAL STRUCTURES TECHNOLOGY RELATED ACTIVITIES AT NASA LEWIS RESEARCH CENTER

DALE A. HOPKINS *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems p 81-89 May 1992
Avail: NTIS HC/MF A22

The presentation gives a partial overview of research and development underway in the Structures Division of LeRC, which collectively is referred to as the Computational Structures Technology Program. The activities in the program are diverse and encompass four major categories: (1) composite materials and structures; (2) probabilistic analysis and reliability; (3) design optimization and expert systems; and (4) computational methods and simulation. The approach of the program is comprehensive and entails exploration of fundamental theories of structural mechanics to accurately represent the complex physics governing engine structural performance, formulation, and implementation of computational techniques and integrated simulation strategies to provide accurate and efficient solutions of the governing theoretical models by exploiting the emerging advances in computer technology, and validation and verification through numerical and experimental tests to establish confidence and define the qualities and limitations of the resulting theoretical models and computational solutions. The program comprises both in-house and sponsored research activities. The remainder of the presentation provides a sample of activities to illustrate the breadth and depth of the program and to demonstrate the accomplishments and benefits that have resulted. Author

N92-25916*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

CSM ACTIVITIES AT THE NASA LANGLEY RESEARCH CENTER

JERROLD M. HOUSNER *In its* Computational Structures Technology for Airframes and Propulsion Systems p 91-120 May 1992

Avail: NTIS HC/MF A22

The objective and goals of the Computational Structural Mechanics (CSM) Program as applied to airframe structures are given. It is recognized that the rapid evolution of computer hardware has opened up new opportunities for solving more complex and larger structural analysis problems than was hitherto imagined. To utilize these computers, new methods of computational structural

mechanics are required. Methods are now being developed, assessed, and validated to meet the goals, and each of these goals is addressed. Plans and approaches are shown and highlights of results achieved in meeting these goals are given. Three research thrusts are shown in the five-year plan: advanced robust CSM methods, large-scale solutions, and validation/demonstration studies. The areas of research activity reflect the CSM goals. The mapping of developed methods onto high-performance and massively parallel computers is an integral part of the CSM five-year plan. Author

N92-25917*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

OVERVIEW OF MECHANICS OF MATERIALS BRANCH ACTIVITIES IN THE COMPUTATIONAL STRUCTURES AREA

C. C. POE, JR. *In its* Computational Structures Technology for Airframes and Propulsion Systems p 121-136 May 1992
Avail: NTIS HC/MF A22

Base programs and system programs are discussed. The base programs include fundamental research of composites and metals for airframes leading to characterization of advanced materials, models of behavior, and methods for predicting damage tolerance. Results from the base programs support the systems programs, which change as NASA's missions change. The National Aerospace Plane (NASP), Advanced Composites Technology (ACT), Airframe Structural Integrity Program (Aging Aircraft), and High Speed Research (HSR) programs are currently being supported. Airframe durability is one of the key issues in each of these system programs. The base program has four major thrusts, which will be reviewed subsequently. Additionally, several technical highlights will be reviewed for each thrust. Author

N92-25918*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

ANALYSIS AND DESIGN TECHNOLOGY FOR HIGH-SPEED AIRCRAFT STRUCTURES

JAMES H. STARNES, JR. and CHARLES J. CAMARDA *In its* Computational Structures Technology for Airframes and Propulsion Systems p 137-172 May 1992
Avail: NTIS HC/MF A22

Recent high-speed aircraft structures research activities at NASA Langley Research Center are described. The following topics are covered: the development of analytical and numerical solutions to global and local thermal and structural problems, experimental verification of analysis methods, identification of failure mechanisms, and the incorporation of analysis methods into design and optimization strategies. The paper describes recent NASA Langley advances in analysis and design methods, structural and thermal concepts, and test methods. Author

N92-25924*# General Electric Co., Cincinnati, OH. Aircraft Engines.

ALGORITHMIC DEVELOPMENT IN STRUCTURES TECHNOLOGY

FRANK SAGENDORPH *In NASA*. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems p 269-302 May 1992
Avail: NTIS HC/MF A22

A wide variety of topics about the types of algorithms in use or in development for the design of gas turbine engines are covered in this report, ranging from the need for better algorithms, to how they should be used. The areas to be addressed in viewgraph format are: why development is needed; how to prioritize it; what is the computing environment; who needs new methods; examples; and the importance of validation. H.A.

N92-25926*# Boeing Commercial Airplane Co., Seattle, WA. Technology and Product Development.

STRUCTURAL ANALYSIS FOR PRELIMINARY DESIGN OF HIGH SPEED CIVIL TRANSPORT (HSCT)

KUMAR G. BHATIA *In NASA*. Langley Research Center, Computational Structures Technology for Airframes and Propulsion

Systems p 321-334 May 1992

Avail: NTIS HC/MF A22

In the preliminary design environment, there is a need for quick evaluation of configuration and material concepts. The simplified beam representations used in the subsonic, high aspect ratio wing platform are not applicable for low aspect ratio configurations typical of supersonic transports. There is a requirement to develop methods for efficient generation of structural arrangement and finite element representation to support multidisciplinary analysis and optimization. In addition, empirical data bases required to validate prediction methods need to be improved for high speed civil transport (HSCT) type configurations. H.A.

N92-25927*# McDonnell-Douglas Corp., Saint Louis, MO.

APPLICATION OF INTEGRATED STRUCTURAL ANALYSIS TO THE HIGH SPEED CIVIL TRANSPORT

C. R. SAFF *In NASA*. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems p 335-357 May 1992
Avail: NTIS HC/MF A22

The Integrated Structural Analysis (ISA) system was developed in response to the need to define lightweight structures early in the design process for military aircraft. The objective of the ISA system is to permit rapid development of an optimized skin and big-bones structure that insures that the requirements of strength, dynamics, loads, and weight are met. While the system was originally developed for fighter aircraft, it is applicable to commercial transports or any other structures. The design requirements dictate the structural arrangement and sizing limitations to be imposed. H.A.

N92-25928*# Northrop Corp., Hawthorne, CA. Structural Methods and Applications Dept.

OVERVIEW OF COMPUTATIONAL STRUCTURAL METHODS FOR MODERN MILITARY AIRCRAFT

J. N. KUDVA *In NASA*. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems p 359-373 May 1992
Avail: NTIS HC/MF A22

Computational structural methods are essential for designing modern military aircraft. This briefing deals with computational structural methods (CSM) currently used. First a brief summary of modern day aircraft structural design procedures is presented. Following this, several ongoing CSM related projects at Northrop are discussed. Finally, shortcomings in this area, future requirements, and summary remarks are given. H.A.

N92-25930*# Grumman Aerospace Corp., Bethpage, NY. Applied Mechanics Lab.

COMPUTATIONAL STRUCTURES TECHNOLOGY AT GRUMMAN: CURRENT PRACTICE/FUTURE NEEDS

ALLAN B. PIFKO and HARVEY EIDINOFF *In NASA*. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems p 395-429 May 1992
Avail: NTIS HC/MF A22

The current practice for the design analysis of new airframe structural systems is to construct a master finite element model of the vehicle in order to develop internal load distributions. The inputs to this model include the geometry which is taken directly from CADAM and CATIA structural layout and aerodynamic loads and mass distribution computer models. This master model is sufficiently detailed to define major load paths and for the computation of dynamic mode shapes and structural frequencies, but not detailed enough to define local stress gradients and notch stresses. This master model is then used to perform structural optimization studies that will provide minimum weights for major structural members. The post-processed output from the master model, load, stress, and strain analysis is then used by structural analysts to perform detailed stress analysis of local regions in order to design local structure with all its required details. This local analysis consists of hand stress analysis and life prediction analysis with the assistance of manuals, design charts, computer

stress and structural life analysis and sometimes finite element or boundary element analysis. The resulting design is verified by fatigue tests. Author

N92-25960* Analytical Services and Materials, Inc., Hampton, VA.

PRELIMINARY STRUCTURAL SIZING OF A MACH 3.0 HIGH-SPEED CIVIL TRANSPORT MODEL

CHARLES L. BLACKBURN Apr. 1992 50 p

(Contract NAS1-19317; RTOP 510-02-12-05)

(NASA-CR-189631; NAS 1.26:189631) Avail: NTIS HC/MF A03

An analysis has been performed pertaining to the structural sizing of a candidate Mach 3.0 High Speed Civil Transport (HSCT) conceptual design using a computer program called EZDESIT. EZDESIT is a computer program which integrates the PATRAN finite element modeling program to the COMET finite element analysis program for the purpose of calculating element sizes or cross sectional dimensions. The purpose of the present report is to document the procedure used in accomplishing the preliminary structural sizing and to present the corresponding results.

Author

N92-25962* Iowa State Univ. of Science and Technology, Ames. Heat Transfer Lab.

WALL FUNCTIONS FOR THE KAPPA-EPSILON TURBULENCE MODEL IN GENERALIZED NONORTHOGONAL CURVILINEAR COORDINATES Final Report

D. L. SONDAK, R. H. PLETCHER, and W. R. VANDALSEM May 1992 129 p Submitted for publication

(Contract NCA2-526; NCC2-476; PROJ. 3335)

(NASA-CR-190368; NAS 1.26:190368; HTL-55; CFD-25;

ISU-ERI-AMES-92259) Avail: NTIS HC/MF A07

A k-epsilon turbulence model suitable for compressible flow, including the new wall function formulation, has been incorporated into an existing compressible Reynolds-averaged Navier-Stokes code, F3D. The low Reynolds number k-epsilon model of Chien (1982) was added for comparison with the present method. A number of features were added to the F3D code including improved far-field boundary conditions and viscous terms in the streamwise direction. A series of computations of increasing complexity was run to test the effectiveness of the new formulation. Flow over a flat plate was computed by using both orthogonal and nonorthogonal grids, and the friction coefficients and velocity profiles compared with a semi-empirical equation. Flow over a body of revolution at zero angle of attack was then computed to test the method's ability to handle flow over a curved surface. Friction coefficients and velocity profiles were compared to test data. All models gave good results on a relatively fine grid, but only the wall function formulation was effective with coarser grids. Finally, in order to demonstrate the method's ability to handle complex flow fields, separated flow over a prolate spheroid at angle of attack was computed, and results were compared to test data. The results were also compared to a k-epsilon model by Kim and Patel (1991), in which one equation model patched in at the wall was employed. Both models gave reasonable solutions, but improvement is required for accurate prediction of friction coefficients in the separated regions. Author

N92-25964* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

A HIGH ANGLE OF ATTACK INVISCID SHUTTLE ORBITER COMPUTATION

WILLIAM L. KLEB and K. JAMES WEILMUNSTER Apr. 1992 23 p

(Contract RTOP 506-40-91-01)

(NASA-TM-107606; NAS 1.15:107606) Avail: NTIS HC/MF A03

As a preliminary step toward predicting the leeside thermal environment for winged reentry vehicles at flight conditions, a computational solution for the flow about the Shuttle Orbiter at wind tunnel conditions was made using a point-implicit, finite volume scheme known as the Langley Aerothermodynamic Upwind Relaxation Algorithm (LAURA). The surface pressures resulting from the computational solution are compared with wind tunnel

data. The results indicate that the dominant inviscid flow features are being accurately predicted on the leeside of the Shuttle Orbiter at a moderately high angle of attack. Author

N92-26125* University of Southern California, Los Angeles. Center for Applied Mathematical Sciences.

ACTIVE NOISE CONTROL: PIEZOCERAMIC ACTUATORS IN FLUID/STRUCTURE INTERACTION MODELS Abstract Only

H. T. BANKS, W. FANG, and R. C. SMITH (Institute for Computer Applications in Science and Engineering, Hampton, VA.) Jun. 1991 2 p

(Contract NAS1-18107; NAG1-1116; AF-AFOSR-0091-90)

(NASA-CR-190328; NAS 1.26:190328) Avail: Issuing Activity

A model for a 2-D acoustic cavity with a flexible boundary (a beam) controlled via piezoceramic patches producing bending moments in the beam is considered. The associated control problem for this fluid/structure interaction system to reduce the acoustic pressure in the cavity involves unbounded control inputs. Approximation methods in the context of an LQR state space formulation are discussed and numerical results are presented to demonstrate the effectiveness of this approach in computing feedback controls for noise reduction. Author

N92-26128* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

STRESS-STRAIN ANALYSIS OF A (0/90)SUB 2 SYMMETRIC TITANIUM MATRIX LAMINATE SUBJECTED TO A GENERIC HYPERSONIC FLIGHT PROFILE

MASSOUD MIRDAMADI (National Academy of Sciences - National Research Council, Hampton, VA.) and W. STEVEN JOHNSON Mar. 1992 27 p Sponsored in part by NAS-NRC

(Contract RTOP 763-23-41-85)

(NASA-TM-107584; NAS 1.15:107584) Avail: NTIS HC/MF A03

Cross ply laminate behavior of Ti-15V-3Cr-3Al-3Sn (Ti-15-3) matrix reinforced with continuous silicon carbide fibers (SCS-6) subjected to a generic hypersonic flight profile was evaluated experimentally and analytically. Thermomechanical fatigue test techniques were developed to conduct a simulation of a generic hypersonic flight profile. A micromechanical analysis was used. The analysis predicts the stress-strain response of the laminate and of the constituents in each ply during thermal and mechanical cycling by using only constituent properties as input. The fiber was modeled using a thermo-viscoplastic constitutive relation. The fiber transverse modulus was reduced in the analysis to simulate the fiber matrix interface failure. Excellent correlation was found between measured and predicted laminate stress-strain response due to generic hypersonic flight profile when fiber debonding was modeled. Author

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GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

A92-38383

AVIATION METEOROLOGY

FRANK DALTON (Meteorological Office, Bracknell, England) Journal of Navigation (ISSN 0373-4633), vol. 45, no. 2, May 1992, p. 252-257.

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A review of weather-related aviation operations shows that despite the introduction of modern avionics on board the aircraft, and automated instrumentation on the ground assisting airfield operations, weather, is still and will continue to be, a vital part of aircraft operations decision-making, affecting the safety and efficiency of flight. New improved communication services will become available in the future so that aircrews can be fully informed

13 GEOSCIENCES

both before their flight, and also in the air, and vital information from the aircraft can be relayed rapidly back to the meteorologist. Increasing air movements with reduced air separations require closer management of flights with up-to-the-minute advice of weather hazards, as well as very accurate temperature and wind information regularly updated. R.E.P.

A92-39044

NOISE FROM TURBINE GENERATORS - NOISE CONTROL, PROPAGATION, AND ASSESSMENT

JORGEN JAKOBSEN (Danish Academy of Technical Sciences, Acoustical Institute, Lyngby, Denmark) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 303-308. refs

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The sources and mechanisms of noise from wind turbines are reviewed with attention given to noise-prediction methods and natural and artificial noise masking. Noise control is discussed in terms of the relative contributions of aerodynamic rotor noise and machinery noise, and noise evaluation techniques are described with references to masking considerations. The general conditions for the audibility of turbine noise are given, and an 'acceptability threshold' is defined that is about 4 dB above the audibility threshold in each critical band. C.C.S.

A92-39045

NOISE GENERATED BY WIND TURBINES

H. W. JONES (Hugh W. Jones and Associates, Ltd., Tantallon, Canada), M. A. LODGE (Atlantic Wind Test Site, Tignish, Canada), T. E. HAYMAN (Hugh W. Jones and Associates, Ltd., Tantallon, Canada), and C. F. BROTHERS (Atlantic Wind Test Site, Tignish, Canada) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 309-312. refs

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An overview is presented of the literature related to standards for describing noise generation by wind turbines emphasizing correlation studies and experimental data. The experimental data relate to measurements of a vertical axis machine, and specimen sets of data are given to demonstrate their interpretation by using six different sets of standards. The standards are based on a variety of techniques and provide different results, and the results for any particular standard do not provide any specific benefit. C.C.S.

A92-39046

MECHANICAL NOISE FROM LARGE WIND TURBINES - EXPERIENCES FROM SWEDISH PROTOTYPES

STEN LJUNGGREN and MELKER JOHANSSON (DNV Ingemansson, AB, Stockholm, Sweden) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 313-316. refs

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Noise due to mechanical causes at two wind turbines is studied with attention given to the pure tones generated by turbine machinery and low-frequency noises caused by wake interactions. It is proposed that audible noise from the turbines should not contain pure tones because they are not easily masked by broad-band sounds such as wind noise. The contributions of air- and structure-borne sounds demonstrate the importance of turbine design. C.C.S.

A92-39050

NATO CCMS AIRCRAFT NOISE STUDY ON RECEIVER TECHNOLOGY

A. N. LEFFERTS (Ministry of Defence, The Hague, Netherlands) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990.

Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 401-406.

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The findings from the NATO Pilot Study on Aircraft Noise are reported as they are relevant to receiver technology with specific details given regarding the effects of noise on humans, noise abatement, and land use. Specific note is made of the lack of clear evidence regarding hearing loss and extraauditory effects in humans that are exposed to sonic booms and other aircraft noise. Noise abatement techniques such as noise barriers are described for ground operations, and moderate noise reduction can be achieved with hush houses during engine testing. Land-use planning is a critical step in noise control, and further research is proposed in such areas as vibration emissions, noise modeling, and the physiological effects of noise. C.C.S.

A92-39051

NOISEMAP 6.0 - THE USAF MICROCOMPUTER PROGRAM FOR AIRPORT NOISE ANALYSIS

ROBERT A. LEE (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 407-411. refs

Copyright

A computer program is described that permits the automated generation of maps showing the cumulative noise-exposure contours around airbases. The Noisemap 6.0 program includes operations-input and contour-plotting subprograms, and the Noisemap methodology is based on a noise database and modeling program that compute noise exposure during runup and flight. In order to conduct a noise analysis the flight configurations are input into the program, and lateral attenuation modeling is conducted and described on a fixed grid by means of a ranked-order summary of operations. C.C.S.

A92-39052

NOISE FROM MILITARY AIRFIELDS IN THE UNITED KINGDOM

RALPH J. WESTON (RAF, Institute of Community and Occupational Medicine, Halton, England) and BERNARD F. BERRY (National Physical Laboratory, Teddington, England) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 413-416. refs

Copyright

The impact of aircraft noise on areas adjacent to military airfields is examined with particular references given to computational models for general aircraft and helicopter noise. The Airnoise modeling technique can map noise-exposure contours resulting from various operations including circuits, and the need for a precise helicopter-noise model is identified. Further development of the Airnoise model with respect to low-level flight and variability in airtracks is proposed in conjunction with a study on noise-health relationships to study the long-term effects of aircraft activity on humans. C.C.S.

A92-39053

AIRPORT NOISE CONTOURS - CONVERTING FROM NNI TO LEQ

J. B. OLLERHEAD (Civil Aviation Authority, Directorate of Operational Research and Analysis, London, England) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 417-420. refs

Copyright

The Noise and Number Index (NNI) for computing noise contours and the Leq contour-calculation technique are described and compared in terms of the accuracy of long-distance calculations. The Leq model was adopted because it can utilize

the same program structure and database as the NNI, and the calibration of the sound-exposure-level (SEL) algorithms is described for implementation of the Leq model. The limitations of the Leq model are described with references to possible SEL computations, cutoffs for event SELs, the effects of atmospheric attenuation, and the impact of aircraft turns and power changes. C.C.S.

A92-39054

AIRCRAFT NOISE - THE CALCULATION OF THE NOISE EXPOSURE BY AIRCRAFT IN THE NETHERLANDS

A. N. LEFFERTS (Ministry of Defence, The Hague, Netherlands) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 421-424. Copyright

This paper examines the use of the Kostenunit (Ke) that is based on the maximum A-weighted noise level for calculating the noise-exposure contours at large airports and military airfields. An expression is presented that provides an acceptable correlation between noise exposure and the noise-hindrance rate based on the Ke noise load. Noise-exposure calculations are based on flight, takeoff, and aircraft-type data, and specific attention is given to the factors related to lateral noise distribution. The present calculation methodology is shown to be particularly useful for the assessment of alternative airfield utilization. C.C.S.

A92-39055

DANSIM - DANISH AIRPORT NOISE SIMULATION MODEL - BASIC PRINCIPLES, EXPERIENCE, AND IMPROVEMENTS

BIRGER PLOVSING and CHRISTIAN SVANE (Danish Acoustical Institute, Lyngby, Denmark) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 425-428. refs

Copyright

A review is presented of the objectives, principles, and methodology upon which the Danish Airport Noise Simulation Model (DANSIM) is based. The noise calculation comprises: (1) aircraft calculations to derive sound-exposure levels (SELs); (2) airport-grid determination and manipulation; and (3) contour calculations and plotting. The DANSIM version IV includes the input of dwelling density in the airport region, and all versions are based on the computation of SEL as functions of distance and aircraft thrust with lateral dispersion. C.C.S.

A92-39056

COMPARISON OF AIRCRAFT NOISE INDICES FOR NOISE ZONING AT MILITARY AIRFIELDS

HEINZ J. GUMMLICH and HEINZ-DIETER MAROHN (Federal Environmental Agency, Berlin, Federal Republic of Germany) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 429-432. refs

Copyright

The aircraft-noise indices of NATO member countries are examined and compared to assess their intrinsic differences and determine a consistent approach for applying the indexing methods. The noise indices from the U.S., UK, Germany, Netherlands, and Norway are compared by regression analysis, by overlaying the contour lines for a single case, and by studying the differences in ground-attenuation factors, horizontal spreading, and thrust treatment in a given case. The results show that the major discrepancies are primarily related to the incorporation of horizontal and vertical spreading around the nominal flight path. C.C.S.

A92-39057

DANSIM APPLICATIONS - DEVELOPMENT OF AIRPORT NOISE REDUCTION STRATEGIES AND ENVIRONMENTAL POLICY

CHRISTIAN SVANE and BIRGER PLOVSING (Danish Acoustical

Institute, Lyngby, Denmark) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 433-438.

Copyright

The use of the Danish Airport Noise Simulation Model (DANSIM) is proposed for four applications with references to land-use planning and environmental issues. The modeling technique is applied to sensitivity studies, runway-use strategy development, the evaluation of noise from staggered runway approaches, and the assessment of aircraft noise at military shooting ranges. Dansim can calculate noise-exposure criteria from several noise scales and indices for complex traffic situations enabling an understanding of runway-traffic scenarios with subtle differences. C.C.S.

A92-39058

COMPUTATION OF AIRCRAFT NOISE EXPOSURE USING DIGITIZED TOPOGRAPHY DATA

IDAR L. N. GRANOIEN, GEROLD OLSEN, and KARE H. LIASJO (Foundation for Scientific and Industrial Research, Trondheim, Norway) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 439-442. refs

Copyright

The use of digitized topographical maps as input data for aircraft-noise-exposure calculations is examined in terms of potential accuracy and feasibility. Attention is focused on a system for computing sound propagation and lateral attenuation called SAE AIR 1751 and the ramifications of introducing the topographical data. The critical corrections to the data include those corresponding to slant range, elevation angle, noise barriers, and hard surfaces. Slant range is treated by calculating the z coordinate, and a routine involving several observation points and terrain smoothing is described for determining the elevation angle. The computer program described could employ digitized topographical data as part of the input data if the method of calculating lateral attenuation is employed. C.C.S.

A92-39059

CALCULATION OF AIRCRAFT NOISE CONTOURS TAKING INTO ACCOUNT THE LATERAL FLIGHT TRACK DISPERSION

U. ISERMANN (Max-Planck-Institut fuer Stroemungsforschung, Goettingen, Federal Republic of Germany) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 443-446. refs

Copyright

A simplified method is presented for describing lateral flight-track dispersion and thereby calculating more accurate aircraft-noise contours. Two geometries of departure routes are simulated to analyze the optimum number of flight tracks required for accurate calculations and low computation times. Deviations of up to +/- 2 dB are possible for time-integrated noise metrics as Leq if lateral dispersion is not included. The analysis shows that by splitting the departure route into between 5 and 7 discrete tracks an adequate description of the time-integrated noise metrics can be determined. C.C.S.

A92-39061

A NOISE SURVEY AROUND OSLO AIRPORT FORNEBU

TRULS GJESTLAND, KARE LIASJO, IDAR GRANOIEN (Foundation for Scientific and Industrial Research, Trondheim, Norway), HANS E. BOHN, and ALICE GAUSTAD (Civil Aviation Administration, Oslo, Norway) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 451-454.

Copyright

A survey is conducted in which human subjects are selected at random within the general vicinity of an airport to study their subjective reactions to increased airport activity and noise. Direct

references are made to the noise levels in the subjects' areas by calculating noise exposure with a predictive model. A noise-dose/response relationship is preliminarily identified and examined in terms of activity interference and societal considerations. C.C.S.

A92-39063**INTERDEPENDENCIES OF AIRCRAFT-/AIRPORT-NOISE AND URBAN- AND REGIONAL-PLANNING STANDARDS**

LOTHAR PRANG (Büro fuer Architektur-Stadtplanung-Infrastruktur, Kaarst, Federal Republic of Germany) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 459-462. Copyright

The relationship between urban planning and airport noise is examined in the light of existing noise-level standards and land-use compatibility issues. The inadequacies of the contour-line system are discussed including the variations of Leq figures and the deviations of aircraft movements. Aircraft-noise monitoring at increased sensitivities is proposed as a means for providing realistic data upon which planning and control methods can be based. C.C.S.

A92-39064**DETERMINATION OF AIRCRAFT NOISE LEVELS WHILE THE ENGINE IS RUNNING ON THE GROUND - AN APPROACH FROM THE POINT OF URBANIZATION AND ARCHITECTURE**

S. YILMAZ (Istanbul Technical University, Turkey) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 463-466. refs

Copyright

Urban planning issues related to aircraft noise propagation are investigated for the case of an aircraft on the ground with its engine running at a range of one mile. Attention is given to the influence of environmental factors such as temperature, atmospheric absorption, and upwind/downwind conditions, and the expressions for determining aircraft noise levels at different receiver points are given. The present treatment of aircraft noise levels related to aircraft running on the ground is shown to be of use in urban planning and architectural design for areas near airports. C.C.S.

A92-39065**DO WE REALLY NEED 57 WAYS OF RATING AIRCRAFT NOISE?**

M. J. T. SMITH (Rolls-Royce, PLC, Derby, England) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 467-470. Previously announced in STAR as N91-10704. refs

Copyright

The difficulties encountered for measuring and quantifying the effects of aircraft noise are analyzed. The impact of the noise measurement results on the air transport business community is discussed. The common element between all noise measurements and control methodologies are given. The relationship between absolute level and footprint area of constant noise level is presented. The noise certification standards are determined. Author

A92-39099**A MOBILE SYSTEM FOR MEASURING AIRPORT NOISE**

EYJOLF OSMUNDSEN (Oslo City Department of Health and Environment, Norway) and KARE H. LIASJO (Foundation for Scientific and Industrial Research, Trondheim, Norway) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 1041-1044. Copyright

A mobile measuring system is described that records flyover noise events that exceed a threshold level with two microphones and a two-channel real-time analyzer. Calculations of the average daily level of flyover noise are compared to the values measured with the present system, and an average deviation of 4 dBA is noted. The measuring system can be improved by using the frequency-analysis mode of the real-time analyzer and by incorporating a dynamic trigger threshold dependent on the background noise level. C.C.S.

A92-39100**NSBIT PROGRAM - DEVELOPMENT OF ASSESSMENT SYSTEM FOR AIRCRAFT NOISE AND RESEARCH ON HUMAN IMPACTS DUE TO AIRCRAFT NOISE**

L. S. FINEGOLD (USAF, Wright-Patterson AFB, OH), S. A. FIDELL (BBN Systems and Technologies Corp., Canoga Park, CA), N. H. REDDINGIUS, and B. A. KUGLER (Acentech, Inc., Canoga Park, CA) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 1115-1120. Research supported by USAF. refs

Copyright

USAF Noise and Sonic Boom Impact Technology (NSBIT) program conducts applied research and development projects to support the development of improved noise propagation models and new information on the effects of aircraft noise on people, animals and structures. This paper describes two areas of NSBIT activity: (1) a computer-based software system referred to as the Assessment System for Aircraft Noise (ASAN) designed to assist USAF route and environmental planners, and (2) a summary of research on the effects of aircraft noise on people. Companion papers in this conference discuss research on aircraft noise and sonic boom effects on animals and structures. The primary purpose of NSBIT's human effects research is to produce scientific data and predictive models that can be incorporated in ASAN. Author

A92-39101**A MODEL FOR THE EFFECTS OF AIRCRAFT OVERFLIGHT NOISE ON THE REPRODUCTIVE SUCCESS OF RAPTORIAL BIRDS**

ANN E. BOWLES, FRANK T. AWBREY (Sea World Research Institute, San Diego, CA), and ROBERT KULL (USAF, Wright-Patterson AFB, OH) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 1129-1132. refs

Copyright

A hypothetical worst-case model is presented that estimates the proportional effect of flight responses induced in raptorial birds which impinge on reproductive success. The probability of a flight response is assumed to be a function of the A-weighted sound level of the aircraft, and attention is given to the effects of habituation. Hypothetical data are introduced into the model indicating that 10 percent of total productivity is lost if nests with a total of 50 eggs or young are exposed to approaches of less than 150 m or sound levels of more than 95 dB at least 100 times. C.C.S.

A92-39102**TRADING NUMBER OF OPERATIONS VERSUS LOUDNESS OF AIRCRAFT**

HUGO FASTL (Muenchen, Technische Universitaet, Munich, Federal Republic of Germany) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 1133-1136. refs

(Contract DFG-SFB-204)

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A pilot study is described in which the relative effects of aircraft loudness and number of noise events are compared. The loudness levels of dated louder aircraft and newer quieter aircraft are considered for a scenario in which four old vs 16 new aircraft conduct operations within a 15-min period. Subjective evaluations

of average loudness are compared to measurements of Leq, and the Leq calculations do not adequately reflect the levels of perceived average loudness. C.C.S.

A92-39103

TEMPORAL CHANGE OF NOISINESS OF HELICOPTER NOISE
SEIICHIRO NAMBA and SONOKO KUWANO (Osaka University, Toyonaka, Japan) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 1171-1176. refs
Copyright

A method for measuring temporally and spatially varying sounds is described based on the methods of continuous judgment by category vs by selected description and used to study helicopter noise. The methods of continuous judgment and selected description by Namba and Kuwano (1988) are reviewed, and three experiments are conducted to study: (1) the instantaneous impression of noisiness using the category method; (2) the instantaneous impression of timbre using the selected-description method; and (3) the overall impression as defined by the semantic differential. Human subjects listening to DAT tapes of helicopter noise appear to have instantaneous impressions of noisiness that depend primarily on sound level. The effects of blade-slap noise during approach are shown to cause some deviation from the general results, and some underestimation of noisiness is associated with the converse phenomenon related to takeoff. C.C.S.

A92-39235

SOME EXPERIENCES WITH COMMUNITY RESPONSE TO LOW LEVELS OF AIRCRAFT NOISE

NICHOLAS P. MILLER and ELENA B. LANGLOIS (Harris, Miller, Miller & Hanson, Inc., Lexington, MA) IN: NOISE-CON 90; Proceedings of the 10th National Conference on Noise Control Engineering, Austin, TX, Oct. 15-17, 1990. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 225-230. refs
Copyright

Earlier studies have been examined to identify factors that describe the noise exposure situation at airports and the resultant community reactions and that provide guidance in anticipating and coping with those reactions. An approach for identifying when significant community reactions may occur, and for minimizing these reactions is proposed. This study focuses on conditions that give rise to negative community reactions to a change, how to anticipate these reactions and how to proceed so that negative reactions are minimized. R.E.P.

A92-39236

AIRCRAFT NOISE AND THE ELDERLY

DEBORAH W. MURPHY (Sarasota-Bradenton Airport, Sarasota, FL) IN: NOISE-CON 90; Proceedings of the 10th National Conference on Noise Control Engineering, Austin, TX, Oct. 15-17, 1990. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 271-274. refs
Copyright

An attempt is made to correlate the frequency response of hearing aids with the frequency spectrum of aircraft noise, to demonstrate that additional annoyance may occur because the weighting network in the hearing aid overemphasizes the objectionable and prominent frequencies occurring in aircraft engine noise. It is shown that there is some correlation between the frequency response curve of a typical hearing aid and the typical frequency spectrums of jet powered aircraft. R.E.P.

A92-39237

EFFECTS OF MILITARY TRAINING ROUTE NOISE ON HUMAN ANNOYANCE

C. S. HARRIS (USAF, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: NOISE-CON 90; Proceedings of the 10th National Conference on Noise Control Engineering, Austin, TX, Oct. 15-17, 1990. Poughkeepsie, NY, Noise

Control Foundation, 1990, p. 297-302. refs
Copyright

Based on preliminary observations that high onset rates along military training routes (MTRs) seem to create startle and contribute directly to the observers perceived annoyance, an interim noise metric was recommended for evaluating the potential annoyance of communities to MTR noise environments. This report focuses on whether high onset flyover (impulsive) noise produces more annoyance than equal energy low onset (nonimpulsive) noise. R.E.P.

A92-39239

ANNOYANCE FROM AIRCRAFT OVERFLIGHTS IN WILDERNESS

ROBIN T. HARRISON, LAWRENCE HARTMANN, A., and WILLIAM J. MAKEL (U.S. Forest Service, San Dimas, CA) IN: NOISE-CON 90; Proceedings of the 10th National Conference on Noise Control Engineering, Austin, TX, Oct. 15-17, 1990. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 327-332. refs
Copyright

An overview is presented of The National Parks Overflight Act of 1987, which includes a mandate to 'conduct an assessment to determine what, if any, adverse impacts to wilderness resources are associated with overflights of National Forest System wilderness areas'. The most important effects of aircraft overflights on some National Parks appears to be created by sightseeing aircraft, while for Forest Service wildernesses, high altitude airline flying, military flying, and lower altitude general aviation operations all are present. R.E.P.

A92-39240

RELATING THE ANNOYANCE OF AIRCRAFT OVERFLIGHTS TO THEIR AUDIBILITY BY OUTDOOR RECREATIONISTS

SANFORD FIDELL and LAURA SILVATI (BBN Systems and Technologies Corp., Canoga Park, CA) IN: NOISE-CON 90; Proceedings of the 10th National Conference on Noise Control Engineering, Austin, TX, Oct. 15-17, 1990. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 339-342. refs
Copyright

It is noted that the relationship between aircraft overflights and ambient sound levels in wildernesses may be an important acoustic basis for the annoyance created; even though the overflights are of low absolute level they may be highly audible in the low ambient environments that often prevail in wilderness settings. The differences between outdoor recreational and residential exposure to aircraft noise, as well as the differences in purposes for characterizing aircraft noise exposure, are sufficiently great to suggest an alternative approach to preparing aircraft noise contours. R.E.P.

N92-25049# Sandia National Labs., Albuquerque, NM.

FATIGUE LIFE VARIABILITY AND RELIABILITY ANALYSIS OF A WIND TURBINE BLADE

P. S. VEERS, H. J. SUTHERLAND, and T. D. ASHWILL 1991 5 p Presented at the American Society of Civil Engineers (ASCE) Specialty Conference on Probabilistic Methods, Albuquerque, NM, 9-11 Jan. 1991
(Contract DE-AC04-76DP-00789)
(DE92-008673; SAND-91-0028C; CONF-9101134-1) Avail: NTIS HC/MF A01

Wind turbines must withstand harsh environments that induce many stress cycles into their components. A numerical analysis package is used to illustrate the sobering variability in predicted fatigue life with relatively small changes in inputs. The variability of the input parameters is modeled to obtain estimates of the fatigue reliability of the turbine blades. DOE

N92-25498# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.

WIND ENERGY PROGRAM OVERVIEW

Feb. 1992 22 p
(Contract DE-AC02-83CH-10093)
(DE91-002178; DOE/CH-10093/101) Avail: NTIS HC/MF A03

This overview emphasizes the amount of electric power that could be provided by wind power rather than traditional fossil fuels. New wind power markets, advances in technology, technology transfer, and wind resources are some topics covered in this publication. DOE

15

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

A92-36895

TMFSLAM - DESIGN ANALYSIS TOOL FOR COATED STRUCTURES

G. S. BECHTEL, R. L. MCKNIGHT, and T. S. COOK (GE Aircraft Engines, Cincinnati, OH) ASME, Transactions, Journal of Engineering for Gas Turbines and Power (ISSN 0742-4795), vol. 114, no. 2, April 1992, p. 309-314. refs
(Contract N62269-88-C-0208)
(ASME PAPER 91-GT-141) Copyright

The large thermal gradients typical of gas turbine hot flowpath components generate thermal strains which, in combination with mechanical loading, can lead to premature failure. The stress and strain fields changes occurring in these components over the course of their operating history must be modeled in order to determine failure parameters and life-limiting locations. A PC-based preliminary design system, TMFSLAM, has been developed for rapid evaluation of the effects of duty cycle, geometry, and materials on component life. Quantitative results on which design changes and materials substitutions can be based are obtained. O.C.

A92-37534

EFFICIENT DIRECT SOLVERS FOR LARGE-SCALE COMPUTATIONAL FLUID DYNAMICS PROBLEMS

W. G. HABASHI (Concordia University, Montreal; Pratt & Whitney Canada, Longueuil), V.-N. NGUYEN, and M. V. BHAT (Pratt & Whitney Canada, Longueuil) (Symposium on Recent Developments in Large-Scale Computational Fluid Dynamics, Minneapolis, MN, Apr. 23, 24, 1990, Technical Papers. A92-37530 15-34) Computer Methods in Applied Mechanics and Engineering (ISSN 0045-7825), vol. 87, no. 2-3, June 1991, p. 253-265. Research supported by Pratt & Whitney Canada. refs
(Contract NSERC-STREQ-040; NSERC-OGPIN-013)
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Results are presented concerning the direct solution of large systems of equations resulting from the fully implicit coupled solution of the Euler and Navier-Stokes equations in three dimensions. Two methods for such direct solution are investigated: the first is based on the application of sparse matrix algorithms and the second on the implementation of a Gauss elimination algorithm optimized for vector-parallel processing on Cray supercomputers. Results indicate that sparse matrix algorithms consistently deteriorate for rectangular ($N \times N \times M$) grids in three dimensions, as M gets larger than N . On the other hand, Gauss elimination seems to be ideally suited for processing on today's supercomputers, achieving execution rates up to 83 percent of the Cray-YMP peak efficiency. Author

A92-37791

ROBUST FREQUENCY DESIGN OF LINEAR STATIONARY SYSTEMS IN AEROAUTOELASTICS

ALEKSANDR G. CHEREMENSKI (Bulgarian Academy of Sciences, Institute of Mechanics and Biomechanics, Sofia, Bulgaria) Journal of Scientific Computing (ISSN 0885-7474), vol. 6, no. 2, June 1991, p. 211-227. Research supported by Bulgarian Science Committee.

refs

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Robust frequency design of linear closed-loop stationary aeroelastic systems (LCLSAES) is considered with the help of doubly coprime fractional representations, linear affine manifolds, and the matrix Corona problem as well as with or without the help of the separation principle. The numerical algorithm is produced by using the finite Lagrange-Sylvester interpolation formulas. An example is given. Author

A92-37950

THE COMPUTER ANALYSIS OF THE PREDICTION OF AIRCRAFT ELECTRICAL POWER SUPPLY SYSTEM RELIABILITY

XINHUA MU, YANGGUANG YAN, and JIBING PEN (Nanjing Aeronautical Institute, People's Republic of China) Nanjing Aeronautical Institute, Journal (ISSN 1000-1956), vol. 23, no. S, Dec. 1991, p. 33-41. In Chinese. refs

With the fast development of aviation technique, the requirements of the aircraft electrical power supply system reliability become much higher. In view of this, the reliability prediction method of simple systems cannot meet the need of research on modern aircraft electrical power supply systems. Therefore, the reliability prediction of complex systems by computers is very significant. In this paper a network model of aircraft electrical power supply system is analyzed according to the reliability theory. The minimal path noncoherent technique and computer realization process are discussed. The program flowchart is given in detail. The reliability of an example aircraft dc electrical power supply system is calculated. Curves of system reliability are obtained by which the basis for the system reliability design is provided. Author

A92-38273

A SEPARATED ALGORITHM AND APPLICATION TO FLIGHT TEST

ZHONGKE SHI and PEIDE WANG (Northwestern Polytechnical University, Xian, People's Republic of China) IN: Aerospace - Collected translations of selected papers (A92-38266 15-01). Xian, People's Republic of China, Northwestern Polytechnical University, 1991, 7 p. Translation. Previously cited in issue 05, p. 706, Accession no. A90-16857. refs

A92-38636#

AN OVERVIEW OF SYSTEMS ENGINEERING MANAGEMENT METHODS AND PROCESSES

THOMAS E. SHAW and JAMES A. LACY (Texas Instruments, Inc., Dallas) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 11 p. refs
(AIAA PAPER 92-1539) Copyright

Techniques, processes, and principles viewed as most important to effective systems engineering management are reviewed. Key elements of systems engineering management plans and key characteristics of the professional staff assigned to product and process development in systems engineering are considered. C.D.

A92-38699*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

ADVANCED TRAINING SYSTEMS FOR THE NEXT DECADE AND BEYOND

R. B. LOFTIN (Houston, University, TX) and ROBERT T. SARELY (NASA, Johnson Space Center, Houston, TX) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 10 p. Research supported by Society for Engineering Education and National Research Council. refs
(Contract NAG9-405)

(AIAA PAPER 92-1626) Copyright

Autonomous training systems grouped under the term intelligent computer-aided training (ICAT) are described with references to their intelligent technologies. An ICAT system was developed for the deployment of the payload-assist module satellites from the Space Shuttle, fault detection in vacuum-vent lines on Spacelab,

main-propulsion pneumatics, and for instrument pointing systems. The basic ICAT architecture is delineated with descriptions of elements such as the user interface, domain expert, training-session manager, trainee model, and training-scenario generator. The ICAT systems employ advanced technologies including knowledge acquisition, virtual environments, and fuzzy logic. The general architecture of the ICAT systems is shown to be fully developed and applicable to the construction of seven different tasks, and the ICAT systems are concluded to enhance the training of aerospace personnel. C.C.S.

A92-39960

ELS PILOT EVALUATION

MARK C. ANDERSON (Honeywell, Inc., Air Transport Systems Div., Phoenix, AZ) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 8 p. refs (SAE PAPER 912107) Copyright

This paper discusses an evaluation program designed to determine the acceptance and effectiveness of an Electronic Library System for commercial flight operations. The program's objective was to determine the needs and applications of the end users, the flight crew, prior to the design of such a complex avionics system. The evaluation program involved over 40 pilots and included testing in a training/classroom environment and in operational flight scenarios in a B727 simulator. In addition to overwhelming acceptance of the Electronic Library System concept, the results of this program demonstrated the importance of a well-designed graphical user interface for flight deck applications.

Author

A92-39961

MULTIDIMENSIONAL ELS USER INTERFACE

JIM CURRAN (Rockwell International Corp., Collins Commercial Avionics Div., Cedar Rapids, IA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 10 p.

(SAE PAPER 912108) Copyright

Intuitive, fast, accurate, and complete access to information on board an aircraft is the goal of an Electronic Library System. This paper describes some of the principles and techniques for achieving efficient and effective access to electronically-stored information.

Author

N92-24397*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

SOFTWARE SURFACE MODELING AND GRID GENERATION STEERING COMMITTEE

ROBERT E. SMITH, ed. Washington Apr. 1992 510 p Workshop held in Hampton, VA, 28-30 Apr. 1992; sponsored by NASA, Washington

(Contract RTOP 505-90-53-02)

(NASA-CP-3143; L-17093; NAS 1.55:3143) Avail: NTIS HC/MF A22 CSCL 09B

It is a NASA objective to promote improvements in the capability and efficiency of computational fluid dynamics. Grid generation, the creation of a discrete representation of the solution domain, is an essential part of computational fluid dynamics. However, grid generation about complex boundaries requires sophisticated surface-model descriptions of the boundaries. The surface modeling and the associated computation of surface grids consume an extremely large percentage of the total time required for volume grid generation. Efficient and user friendly software systems for surface modeling and grid generation are critical for computational fluid dynamics to reach its potential. The papers presented here represent the state-of-the-art in software systems for surface modeling and grid generation. Several papers describe improved techniques for grid generation.

N92-24400*# McDonnell Aircraft Co., Saint Louis, MO.

GEOMETRY ACQUISITION AND GRID GENERATION: RECENT EXPERIENCES WITH COMPLEX AIRCRAFT CONFIGURATIONS

TIMOTHY D. GATZKE, WALTER F. LABOZZETTA, JOHN W.

COOLEY, and GREGORY P. FINFROCK /In NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee p 31-43 Apr. 1992

Avail: NTIS HC/MF A22 CSCL 09B

Important issues involved in working with complex geometries are discussed. Approaches taken to address complex geometry issues in the McDonnell Aircraft Computational Grid System and related geometry processing tools are discussed. The efficiency of acquiring a suitable geometry definition, the need to manipulate the geometry, and the time and skill level required to generate the grid while preserving geometric fidelity are discussed. Author

N92-24411*#

National Aerospace Lab., Amsterdam (Netherlands).

DOMAIN MODELING AND GRID GENERATION FOR MULTI-BLOCK STRUCTURED GRIDS WITH APPLICATION TO AERODYNAMIC AND HYDRODYNAMIC CONFIGURATIONS

S. P. SPEKREIJSE, J. W. BOERSTOEL, P. L. VITAGLIANO, and J. L. KUYVENHOVEN (Fokker B.V., Schiphol-Oost, Netherlands) /In NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee p 207-229 Apr. 1992 (Contract NIVR-01604-N)

Avail: NTIS HC/MF A22 CSCL 09B

About five years ago, a joint development was started of a flow simulation system for engine-airframe integration studies on propeller as well as jet aircraft. The initial system was based on the Euler equations and made operational for industrial aerodynamic design work. The system consists of three major components: a domain modeller, for the graphical interactive subdivision of flow domains into an unstructured collection of blocks; a grid generator, for the graphical interactive computation of structured grids in blocks; and a flow solver, for the computation of flows on multi-block grids. The industrial partners of the collaboration and NLR have demonstrated that the domain modeller, grid generator and flow solver can be applied to simulate Euler flows around complete aircraft, including propulsion system simulation. Extension to Navier-Stokes flows is in progress. Delft Hydraulics has shown that both the domain modeller and grid generator can also be applied successfully for hydrodynamic configurations. An overview is given about the main aspects of both domain modelling and grid generation.

Author

N92-24419*# Boeing Commercial Airplane Co., Seattle, WA. Aerodynamics Research and Engineering Div.

AN INTERACTIVE MULTI-BLOCK GRID GENERATION SYSTEM

T. J. KAO, T. Y. SU, and RUTH APPLEBY (Boeing Computer Services Co., Seattle, WA.) /In NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee p 333-345 Apr. 1992

Avail: NTIS HC/MF A22 CSCL 09B

A grid generation procedure combining interactive and batch grid generation programs was put together to generate multi-block grids for complex aircraft configurations. The interactive section provides the tools for 3D geometry manipulation, surface grid extraction, boundary domain construction for 3D volume grid generation, and block-block relationships and boundary conditions for flow solvers. The procedure improves the flexibility and quality of grid generation to meet the design/analysis requirements.

Author

N92-24424*# International Business Machines Corp., Yorktown Heights, NY. Research Div.

ON CONSTRUCTING THREE-DIMENSIONAL OVERLAPPING GRIDS WITH CMPGRD

WILLIAM D. HENSHAW, GEOFFREY CHESHIRE, and MICHAEL E. HENDERSON /In NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee p 415-434 Apr. 1992

Avail: NTIS HC/MF A22 CSCL 09B

Techniques for the construction of three-dimensional composite overlapping grids, using the grid construction program CMPGRD, are described. The overlapping approach can be used to generate

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grids for regions of complicated geometry. The grids can be constructed to be smooth and free from coordinate singularities. The ability to create smooth grids for complicated regions is an important first step towards the accurate numerical solution of partial differential equations. The creation of grids for surfaces defined by cross-sections such as an airplane wing is described. A method for integrating the patched surfaces generated by a computer aided design (CAD) package with the CMPGRD program is described. Additionally, the creation of grids in regions where surfaces intersect is described. Author

N92-24428* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A MULTIBLOCK GRID GENERATION TECHNIQUE APPLIED TO A JET ENGINE CONFIGURATION

MARK E. M. STEWART *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee p 477-485 Apr. 1992

Avail: NTIS HC/MF A22 CSDL 09B

Techniques are presented for quickly finding a multiblock grid for a 2D geometrically complex domain from geometrical boundary data. An automated technique for determining a block decomposition of the domain is explained. Techniques for representing this domain decomposition and transforming it are also presented. Further, a linear optimization method may be used to solve the equations which determine grid dimensions within the block decomposition. These algorithms automate many stages in the domain decomposition and grid formation process and limit the need for human intervention and inputs. They are demonstrated for the meridional or throughflow geometry of a bladed jet engine configuration. D.R.D.

N92-25190* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CONSTRAINT-BASED SCHEDULING

MONTE ZWEBEN Sep. 1991 19 p

(NASA-TM-107873; NASA-FIA-91-27; NAS 1.15:107873) Avail: NTIS HC/MF A03

The GERRY scheduling system developed by NASA Ames with assistance from the Lockheed Space Operations Company, and the Lockheed Artificial Intelligence Center, uses a method called constraint based iterative repair. Using this technique, one encodes both hard rules and preference criteria into data structures called constraints. GERRY repeatedly attempts to improve schedules by seeking repairs for violated constraints. The system provides a general scheduling framework which is being tested on two NASA applications. The larger of the two is the Space Shuttle Ground Processing problem which entails the scheduling of all inspection, repair, and maintenance tasks required to prepare the orbiter for flight. The other application involves power allocations for the NASA Ames wind tunnels. Here the system will be used to schedule wind tunnel tests with the goal of minimizing power costs. In this paper, we describe the GERRY system and its applications to the Space Shuttle problem. We also speculate as to how the system would be used for manufacturing, transportation, and military problems. Author

N92-25264* MCAT Inst., San Jose, CA.

ALGORITHM AND CODE DEVELOPMENT FOR UNSTEADY THREE-DIMENSIONAL NAVIER-STOKES EQUATIONS Annual Report

SHIGERU OBAYASHI Mar. 1992 38 p Original contains color illustrations

(Contract NCC2-605)

(NASA-CR-190077; NAS 1.26:190077; MCAT-92-005) Avail: NTIS HC/MF A03; 2 functional color pages

The code, ENSAERO, is being developed for computing the unsteady aerodynamics and aeroelasticity of aircraft and it solves the Euler/Navier-Stokes equations. During the past year, the code has been applied to transonic flows about complicated geometries, such as flows over a wing-body configuration and a wing with an oscillating control surface. Simulations over a wing-body configuration were performed. The treatment of zonal interface

was tested for steady and unsteady cases. The results were validated by comparison with other data. Flows over wing with a moving control surface were computed. The results were validated through comparisons with experimental data. The Baldwin-Barth and Johnson-King models were incorporated into ENSAERO.

Author

N92-25306* Technische Univ., Delft (Netherlands).

DELFI: DESIGN, DEVELOPMENT, AND APPLICABILITY OF EXPERT SYSTEMS SHELLS Ph.D. Thesis

HINDRIK DESWAANARONS 1991 300 p

(ISBN-90-6275-734-0; ETN-92-91295) Copyright Avail: NTIS HC/MF A13

The two rule based systems Delfi2 and Delfi2+ and the frame based system Delfi3 are addressed. The various concepts of knowledge representation, inference, and inexact reasoning are discussed as introduction. The Delfi project is outlined and design and evolution of the above systems are described. The applicability of both rule and frame based expert systems is discussed. Applications in medical diagnosis and therapy, financial advice, and aircraft maintenance are chosen as illustrative examples. The time aspects of expert systems on a real time environment are studied. Online knowledge based scheduling is extensively discussed. ESA

N92-25726* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ACTIVITIES FOR NUMERICAL PROPULSION SYSTEMS SIMULATION PROGRAM

AUSTIN L. EVANS *In* its Workshop on Grid Generation and Related Areas p 151-157 Apr. 1992

Avail: NTIS HC/MF A08

The Interdisciplinary Technology Office (ITO) has been tasked with the responsibility of coordinating interdisciplinary research and technology programs; establish and maintain interface with the various disciplines at LeRC, industry, government, and academic organizations; and facilitating the exploitation of advances in the individual disciplinary efforts that have multidisciplinary implications. H.A.

N92-25913* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

COMPUTER CODES DEVELOPED AND UNDER DEVELOPMENT AT LEWIS

CHRISTOS C. CHAMIS *In* NASA. Langley Research Center, Computational Structures Technology for Airframes and Propulsion Systems p 43-57 May 1992

Avail: NTIS HC/MF A22

The objective of this summary is to provide a brief description of: (1) codes developed or under development at LeRC; and (2) the development status of IPACS with some typical early results. The computer codes that have been developed and/or are under development at LeRC are listed in the accompanying charts. This list includes: (1) the code acronym; (2) select physics descriptors; (3) current enhancements; and (4) present (9/91) code status with respect to its availability and documentation. The computer codes list is grouped by related functions such as: (1) composite mechanics; (2) composite structures; (3) integrated and 3-D analysis; (4) structural tailoring; and (5) probabilistic structural analysis. These codes provide a broad computational simulation infrastructure (technology base-readiness) for assessing the structural integrity/durability/reliability of propulsion systems. These codes serve two other very important functions: they provide an effective means of technology transfer; and they constitute a depository of corporate memory. Author

N92-26018* Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.

ITERATIVE METHODS FOR LARGE SCALE STATIC ANALYSIS OF STRUCTURES ON A SCALABLE MULTIPROCESSOR

SUPERCOMPUTER Final Report, period ended 31 May 1992

NAHIL ATEF SOBH Jun. 1992 15 p

(Contract NAG1-1291)

(NASA-CR-190369; NAS 1.26:190369) Avail: NTIS HC/MF A03

A parallel Preconditioned Conjugate Gradient (PCG) iterative solver has been developed and implemented on the iPSC-860 scalable hypercube. This new implementation makes use of the Parallel Automated Runtime Toolkit at ICASE (PARTI) primitives to efficiently program irregular communications patterns that exist in general sparse matrices and in particular in the finite element sparse stiffness matrices. The iterative PCG has been used to solve the finite element equations that result from discretizing large scale aerospace structures. In particular, the static response of the High Speed Civil Transport (HSCT) finite element model is solved on the iPSC-860. H.A.

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PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

A92-38923

INVESTIGATION ON EFFECTS ON ENHANCING LIFT BY ACOUSTIC EXCITATION

YAO LONG HO and QIZHENG LU (China Aerodynamics Research and Development Center, Mianyang, People's Republic of China) Acta Aerodynamica Sinica (ISSN 0258-1825), vol. 10, no. 1, March 1992, p. 140-145. In Chinese. refs

A low-speed wind-tunnel test shows that beneficial effects on enhancing lift can be obtained by using internal acoustic excitation to control the shedding vortices. The relations between the excited frequency, the main-vortex naturally shedding frequency, and the main-vortex shedding frequency are given. Regularities of the surface pressure with the sound-pressure level and frequency are also given. This paper provides important experimental results for the applied study of internal acoustic excitation of a 2D airfoil or a delta wing. Author

A92-39042

INTER-NOISE 90; PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NOISE CONTROL ENGINEERING, GOTEBOG, SWEDEN, AUG. 13-15, 1990. VOLS. 1 & 2

HANS G. JONASSON, ED. (Swedish National Testing Institute, Boras, Sweden) Conference sponsored by International Institute of Noise Control Engineering, Chalmers University of Technology, STU, et al. Poughkeepsie, NY, Noise Control Foundation, 1990, p. Vol. 1, 738 p.; vol. 2, 762 p. For individual items see A92-39043 to A92-39112.

(ISBN 91-7848-224-0) Copyright

The present conference on noise-control engineering encompasses building acoustics issues such as sound absorption and scattering and sound-intensity applications, environmental noise from wind turbines and aircraft, duct acoustics, noise labeling, sound-power measurements, and issues related to sound propagation of environmental noise. Specific issues addressed include modal and holographic analyses of window sound insulation, poles and zeros in reverberant sound-field transfer functions, sound absorption by porous flexible materials, noise control and propagation in wind turbines, and measurements of meteorological effects on sound propagation near the ground. Also addressed are airport noise contours, an advanced method for single-event aircraft-noise analysis, the determination of aircraft noise levels while the engine is running on the ground, aeroacoustic wind-tunnel tests on full-scale propellers with unsymmetrical blade spacing, and the measurement of the scattering matrix of acoustical two-port sources. C.C.S.

A92-39060

ADVANCED METHOD FOR SINGLE EVENT AIRCRAFT NOISE ANALYSIS

K. H. LIASJO, H. OLSEN, and I. L. N. GRANOIEN (Foundation for Scientific and Industrial Research, Trondheim, Norway) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 447-450. refs

Copyright

A digital recording technique is described that permits the calculation of noise-source parameters from single aircraft noise events. Simulations of flyovers are employed to adjust analog sound recordings to describe aircraft noise as a function of slant distance and aircraft engine operation. Measured data are described which demonstrate the effective treatment of parameters such as source directivity, spectral variation, and distance-dependent attenuation. C.C.S.

A92-39062

DISTRIBUTION OF MAXIMUM LEVELS OF AIRCRAFT NOISE AROUND THEIR MEAN VALUE

THOMAS J. MEYER IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 455-458.

Copyright

This paper analyzes the scatter of maximum noise levels around the mean value under different boundary conditions in order to assess the rate of occurrence of the mean maximum level. The statistical distribution of maximum noise levels is demonstrated in four cases to describe ranges of possible differences and the possibility of exceeding maximum noise levels. The calculations show that statistical distributions permit more accurate descriptions of maximum noise levels than does the mean value alone. C.C.S.

A92-39066

AZIMUTHAL NOISE CHARACTERISTICS OF CONTRA-ROTATING PROPELLERS - RESULTS OF A WIND TUNNEL MODEL TEST

B. GEHLAR and W. DOBRZYNSKI (DLR, Institut fuer Entwurfsaerodynamik, Braunschweig, Federal Republic of Germany) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 471-474. refs

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An experimental investigation is conducted to evaluate the noise characteristics of counterrotating propellers (propfans) for comparison with those from single-rotating propellers. Various propfan configurations are studied in an acoustic wind tunnel showing that propfan noise spectra have increased levels of high-frequency noise. Also noted are: (1) pronounced azimuthal sound-pressure-level directivities; (2) two maxima in the polar directivities of both the high-frequency harmonic and the A-weighted levels; and (3) a lower gradient of A-weighted sound-pressure levels vs Mach number. C.C.S.

A92-39068

THEORETICAL AND EXPERIMENTAL METHODS IN ACOUSTICS OF DUCTS AND MUFFLERS - A CRITICAL REVIEW

M. L. MUNJAL (Indian Institute of Science, Bangalore, India) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vol. 1. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 519-524. refs

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An overview is presented regarding the theoretical and experimental investigation of the acoustics of ducts and mufflers and noise-control methods. The plane-wave analysis of reflective mufflers is reviewed with particular attention given to source

characterization and modeling of the muffler elements. The paper then describes the 3D analysis of expansion chambers by means of finite-element approaches in the time and frequency domains. Attention is given to the treatment of acoustically lined ducts, measurements in flow ducts, and active noise control in ducted fans. The frequency-domain characterization of engine-exhaust systems is based on a complex time-varying geometry. Perforated elements and sudden area changes can be studied by means of 3D analyses that incorporate both dissipative and convective flow effects. Active noise-control systems are shown to be an effective alternative to passive damping for the systems discussed.

C.C.S.

A92-39085**COUPLED PROPELLER CONTRIBUTIONS TO AIRCRAFT NOISE AND VIBRATION**

URBAN EMBORG (Saab-Scania, AB, Linköping, Sweden) and WILLIAM G. HALVORSEN (Ingemansson Anatrol, AB, Askim, Sweden) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Göteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 821-824. refs
Copyright

In-flight sound and vibration data from a twin-engine aircraft are studied by means of signal processing to assess the contributions of each propeller and analyze the coupling of the sound fields. Cross-spectrum averaging is employed for separating the closely spaced pure tones generated by the two propellers on a commuter aircraft. The separated operating deflection shapes (ODSs) are measured with 50 accelerometers mounted in the fuselage in the plane of the propellers. Combined ODSs are computed for five different synchrophase angles of -40 to 40 deg, and increases in fuselage structural damping are found to reduce the forced-response contributions of modes close to the excitation frequency. When the independent contributions of the propellers are about equal significant variation is noted in combined level with synchrophase angle.

C.C.S.

A92-39086**EVALUATION OF SOUND TRANSMISSION INTO AIRCRAFT FUSELAGES BY A RECIPROCITY TECHNIQUE**

J. M. MASON and F. J. FAHY (Southampton, University, England) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Göteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 825-828. Research supported by Department of Trade and Industry of England.
Copyright

This paper discusses the continuing development of a new experimental technique for characterizing sound transmission into structures using reciprocity principles. Transfer function measurements are made from a point source inside a fuselage model to the transduced vibration on its outside surface. It is demonstrated, for a localized excitation of a fuselage model, that the reciprocity relationship employed is valid, and that sound transmission is accurately represented. Further, it is shown that the resulting internal sound pressure level inside four cylinder configurations is not just sensitive to the structural parameters, but also to the form of the acoustic excitation field.

Author

A92-39088**STUDY MODEL FOR THE REDUCTION OF NOISE THROUGH DOUBLE WALL CYLINDRICAL SHELLS - COMPARISON WITH EXPERIMENTATION**

C. CACCIOLATI (Lyon, Institut National des Sciences Appliquées, Villeurbanne, France) and M. GOULAIN (Aerospatiale, Toulouse, France) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Göteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 833-836. refs
Copyright

Fluid-structure coupling in a double shell of finite length is modeled to study the effect of external acoustic excitation on a

finite system and determine the validity envelope. The theoretical model is set forth for two cylindrical shells supported on rigid bulkheads and then applied to a small hypothetical shell structure. An analogous experiment is conducted in an anechoic chamber on an external light-alloy shell to measure 200 frequency points in geometric progression. Ring frequencies are identified at 1100 and 1900 Hz which agrees with the theoretical predictions, and some differences are observed and attributed to the estimation of acoustic damping effects. The results demonstrate the bounds of the validity envelope for modeling finite double shells, and the experimental process can be employed to efficiently provide narrow-band data.

C.C.S.

A92-39104**TEMPORAL CHANGE OF TIMBRE OF HELICOPTER NOISE**

SONOKO KUWANO and SEIICHIRO NAMBA (Osaka University, Toyonaka, Japan) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Göteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 1177-1180. refs
Copyright

The methods of continuous judgment by selected description and by category developed by Namba and Kuwano (1988) are employed to study the impression of timbre of helicopter noise. The instantaneous impression of timbre is studied with human subjects by means of the method of continuous judgment, and the overall impression of the noises is evaluated using the semantic differential. Comparisons with fixed-wing aircraft noise shows that helicopter noise can be evaluated in the same manner as that for aircraft noise, and the use of Leq to study helicopter noise is shown to be insufficient when timbre is considered.

C.C.S.

A92-39106**ACTIVE CONTROL OF STRUCTURALLY-COUPLED SOUND FIELDS GENERATED BY LOCALIZED FORCE INPUTS**

V. R. SONTI, P. S. CHANG, and J. D. JONES (Purdue University, West Lafayette, IN) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Göteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 1259-1262. Research supported by Sikorsky Aircraft. refs
(Contract NSF MSM-88-10384)
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The use of high-authority point-control actuators is investigated as a means for reducing localized power flow into lightweight fuselage-type structures under conditions other than resonance. A steel cylinder with acoustic and structural damping is subjected to vibrations, and optimized control is achieved when the control shaker is located close to the primary force input. An accelerometer is shown to be more effective than an interior microphone as an error sensor because it provides a feedback signal suitable for global control of shell vibration and interior noise.

C.C.S.

A92-39109**ACTIVE CONTROL OF PULSED FLOW FOR LOW FREQUENCY NOISES ATTENUATION**

J. LAUMONIER, J. TARTARIN, and J. L. PEUBE (Poitiers, Université, France) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Göteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 1293-1296. refs
Copyright

An active 'antipulsatory' device comprising a low-resolution activator and controls is described and demonstrated for the attenuation of noises emitted by industrial airflows. The development of an automated version of the device is considered with attention given to the applicable frequency range and its ability to attenuate the fundamental and first harmonics of airflow noises. The conditions of optimal attenuation are described, and it is shown that an automated system based on these principles can be effective in the active treatment of industrial noise and/or vibration.

C.C.S.

A92-39111

ACTIVE CONTROL OF AIRBORNE NOISE TRANSMITTED THROUGH A RIBBED PANEL

G. CHATEL (SECAV, Marseille, France), A. FRANCES (Direction des Constructions Navales, Toulon, France), and A. ROURE (CNRS, Laboratoire de Mécanique et d'Acoustique, Marseille, France) IN: Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Göteborg, Sweden, Aug. 13-15, 1990. Vol. 2. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 1301-1304. refs

Copyright

A modal analysis is conducted to study active noise control of a steel panel with low-frequency acoustic insulation, and comparisons to experiment are given. Active noise control is based on synchronous synthesis method of multidimensional cancellation, and the transverse deflection of the vibrating plate is analyzed using modal shape functions. The flow of energy through a closed surface is computed to define the acoustic power radiated by the panel vibrating on each separate mode. Illustrations of the panel's velocity pattern and radiated intensity measurement are presented for the cases of no active actuators vs three active actuators. The cancellation of first modes and the increase of higher-order modes is demonstrated along with an incumbent decrease in the radiation of power (10-15 dB) for frequencies of 50-80 Hz. The experimental and analytical results confirm the effectiveness of the active insulation method for reducing airborne noise transmission. C.C.S.

A92-39226

NOISE-CON 90; PROCEEDINGS OF THE 10TH NATIONAL CONFERENCE ON NOISE CONTROL ENGINEERING, UNIVERSITY OF TEXAS, AUSTIN, OCT. 15-17, 1990

ILENE J. BUSCH-VISHNIAC, ED. Conference sponsored by University of Texas and Institute of Noise Control Engineering. Poughkeepsie, NY, Noise Control Foundation, 1990, 512 p. For individual items see A92-39227 to A92-39243.

(ISBN 0-931784-21-2) Copyright

Topics presented include a test fixture for measuring small fan vibration, the statistical energy analysis of a geared rotor system, helicopter far-field acoustic levels as a function of reduced rotor speeds, and the stability of active noise control systems in ducts. Also presented are active control of the force response of a finite beam, the selection of noise monitoring sites for Logan airport and Hanscom field, aircraft noise and the elderly, and the development of multiple-input models for airborne noise prediction. R.E.P.

A92-39228* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

HELICOPTER FAR-FIELD ACOUSTIC LEVELS AS A FUNCTION OF REDUCED ROTOR SPEEDS

ARNOLD W. MUELLER, PHILIP LEMASURIER, and CHARLES D. SMITH (NASA, Langley Research Center, Hampton, VA) IN: NOISE-CON 90; Proceedings of the 10th National Conference on Noise Control Engineering, Austin, TX, Oct. 15-17, 1990. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 95-100. refs

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This paper will present far-field measured noise levels relative to tests conducted with a model S-76A helicopter. The project was designed to provide supplemental experimental flight data which may be used to further study reduced helicopter rotor speeds (and thus, advancing blade-tip Mach number) effects on far-field acoustic levels. The aircraft was flown in straight and level flight while operating with both the rotor speed and flight speed as test variables. The rotor speed was varied over the range of 107 percent of the main-rotor speed (NR) to 90 percent NR and with the forward flight speed varied over the range of 155 to 35 knots indicated air speed. These conditions produced a wide range of advancing blade-tip Mach numbers to which the noise data are related. Author

A92-39238* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

LOUDNESS OF SHAPED SONIC BOOMS

KEVIN P. SHEPHERD (NASA, Langley Research Center, Hampton, VA) and BRENDA M. SULLIVAN (Lockheed Engineering and Sciences Co., Hampton, VA) IN: NOISE-CON 90; Proceedings of the 10th National Conference on Noise Control Engineering, Austin, TX, Oct. 15-17, 1990. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 309-314. refs

Copyright

A loudness model is adopted to study the feasibility of designing and operating a supersonic transport to produce minimized sonic booms. The loudness contours in this technique extend to a lower frequency (1 Hz) and thus are appropriate for sonic booms that contain significant low frequency energy. Input to the loudness calculation procedure is the power spectral density of the pressure-time signature. Calculations of loudness, for both indoor and outdoor conditions, demonstrate that shaped sonic booms are potentially more acceptable than N-waves possessing the same peak overpressure. R.E.P.

A92-39241* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A REVIEW OF COMPUTATIONAL/EXPERIMENTAL METHODOLOGY DEVELOPMENTS IN AEROACOUSTICS

L. A. EAGLESON (Texas A & M University, College Station) IN: NOISE-CON 90; Proceedings of the 10th National Conference on Noise Control Engineering, Austin, TX, Oct. 15-17, 1990. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 345-350. refs

(Contract NAG3-354)

Copyright

A number of studies in the area of propeller design and advanced configuration performance/acoustics are reviewed. Various designs are analyzed in the area of propeller efficiency, lift-to-drag ratio, and differential thrust and power coefficients. Predictions are compared to experiment and the numerical analyses are examined for restrictions and potential enhancements. R.E.P.

A92-39243

THE DEVELOPMENT OF MULTIPLE-INPUT MODELS FOR AIRBORNE NOISE PREDICTION

MURTY S. KOMPELLA and ROBERT J. BERNHARD (Purdue University, West Lafayette, IN) IN: NOISE-CON 90; Proceedings of the 10th National Conference on Noise Control Engineering, Austin, TX, Oct. 15-17, 1990. Poughkeepsie, NY, Noise Control Foundation, 1990, p. 469-474. refs

Copyright

Linear algebraic methods are employed to (1) identify the location and minimum number of transducers needed to sufficiently characterize the source, (2) identify the minimum number of transmission paths required to sufficiently characterize the airborne transmission, and (3) put the information from (1) and (2) together to form a reduced and sufficient multiple-input system model. A noise source and path technique, based on rank determination utilizing SVD and Gaussian elimination to reduce a matrix to row echelon form, is described. Experimental application and verification of these methods are presented. R.E.P.

A92-39480

CHAOTIC MOTION IN MECHANICAL AND ENGINEERING SYSTEMS

A. STEINDL and H. TROGER (Wien, Technische Universität, Vienna, Austria) IN: Engineering applications of dynamics of chaos. Vienna, Springer-Verlag, 1991, p. 149-223. refs (Contract FFWF PROJECT P-7003)

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The conditions are described which must be fulfilled by a mechanical system to be a chaotic process defined by relating the time evolution of a deterministic mechanical system governed by Newton's laws to the stochastic sequence of repeatedly tossing a fair coin. This definition basically requires the occurrence of

transversal homoclinic points and results in the existence of the horseshoe and shift map. The concepts of center manifolds and inertial manifolds are introduced, and an extensive treatment of the Melnikov method is given. A numerical method is explained which permits the existence of transversal homoclinic points to be established. Applications are presented for simple mechanical systems, including a satellite on an elliptic orbit. C.D.

A92-40390* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

1991-92 AHS TECHNICAL COMMITTEE HIGHLIGHTS - ACOUSTICS

KENNETH S. BRENTNER (NASA, Langley Research Center, Hampton, VA) Vertiflite (ISSN 0042-4455), vol. 38, no. 3, May-June 1992, p. 68-71.

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Progress made in 1991-92 in rotorcraft noise technology is reviewed. Flight testing of the SV-15 Tiltrotor Research Aircraft fitted with Advanced Technology Blades, noise prediction research conducted at NASA Langley, and noise reduction studies which have demonstrated significant noise reduction using higher harmonic control are discussed. C.D.

A92-40588

ACOUSTIC SCATTERING BY A DISK OR ANNULUS LINKING TWO CONCENTRIC CYLINDRICAL SHELLS. I - THEORY AND RESULTS FOR HEAVY EXTERIOR FLUID LOADING. II - RESULTS FOR HEAVY EXTERIOR FLUID LOADING ON BOTH SHELLS

E. A. SKELTON (Imperial College of Science, Technology, and Medicine, London, England) Journal of Sound and Vibration (ISSN 0022-460X), vol. 154, no. 2, April 22, 1992, p. 205-248. Research supported by Ministry of Defence Procurement Executive. refs

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The scattering of a plane sound wave incident upon a system of two concentric elastic shells is investigated. The shells are linked by a disk or annulus which can undergo rigid body motion only. The shells are linked in such a way that only reaction forces can be transmitted to the shells, and they are surrounded by a compressible fluid which may also occupy the region between the shells. A formal solution for the scattered pressure is obtained and investigated asymptotically for the case when the exterior fluid provides heavy fluid loading on the outer shell with no fluid between the shells. The obtained solution is then investigated asymptotically when the heavy fluid also occupies the region between the shells. In this case the additional limits of either large or small shell spacing are employed. S.A.V.

A92-40866

PRESSURIZATION EFFECTS IN KINEMATIC HEAT ENGINES

J. R. SENFT (Wisconsin, University, River Falls) Franklin Institute, Journal (ISSN 0016-0032), vol. 328, no. 2-3, 1991, p. 255-279. refs

(Contract NSF CBT-87-05576)

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A general treatment of the effects of pressurizing or supercharging reciprocating kinematic engines is presented. This is done in a broad new context which permits analysis of engines with multistroke cycles, pumping loops, and variable buffer pressure. The concept of a monomorphic engine is introduced to analyze various schemes for improving engine performance by charging the workspace or bufferspace. Ideal Stirling engines are shown to have the maximum performance levels possible for general reciprocating engines and so represent the upper limit of pressurization effects. Author

N92-24251* Continuum Dynamics, Inc., Princeton, NJ.

ANALYSIS OF ROTOR VIBRATORY LOADS USING HIGHER HARMONIC PITCH CONTROL Final Report

TODD R. QUACKENBUSH, DONALD B. BLISS, ALEXANDER H. BOSCHITSCH, and DANIEL A. WACHSPRESS Apr. 1992 61 p

(Contract NAS1-19160; RTOP 532-06-37)

(NASA-CR-189591; NAS 1.26:189591; CDI-91-03) Avail: NTIS HC/MF A04 CSCL 20A

Experimental studies of isolated rotors in forward flight have indicated that higher harmonic pitch control can reduce rotor noise. These tests also show that such pitch inputs can generate substantial vibratory loads. The modification is summarized of the RotorCRAFT (Computation of Rotor Aerodynamics in Forward flight) analysis of isolated rotors to study the vibratory loading generated by high frequency pitch inputs. The original RotorCRAFT code was developed for use in the computation of such loading, and uses a highly refined rotor wake model to facilitate this task. The extended version of RotorCRAFT incorporates a variety of new features including: arbitrary periodic root pitch control; computation of blade stresses and hub loads; improved modeling of near wake unsteady effects; and preliminary implementation of a coupled prediction of rotor airloads and noise. Correlation studies are carried out with existing blade stress and vibratory hub load data to assess the performance of the extended code. Author

N92-24688* Sverdrup Technology, Inc., Brook Park, OH.

A SOPHISTICATED, MULTI-CHANNEL DATA ACQUISITION AND PROCESSING SYSTEM FOR HIGH FREQUENCY NOISE RESEARCH Final Report

DAVID G. HALL and JAMES BRIDGES Mar. 1992 8 p Proposed for presentation at the 1992 International Congress on Noise Control Engineering, Toronto, Ontario, 20-22 Jul. 1992; sponsored by the International Inst. of Noise Control Engineering (Contract NAS3-25266; RTOP 537-02-23)

(NASA-CR-189137; E-6936; NAS 1.26:189137) Avail: NTIS HC/MF A02 CSCL 20A

A sophisticated, multi-channel computerized data acquisition and processing system was developed at the NASA LeRC for use in noise experiments. This technology, which is available for transfer to industry, provides a convenient, cost-effective alternative to analog tape recording for high frequency acoustic measurements. This system provides 32-channel acquisition of microphone signals with an analysis bandwidth up to 100 kHz per channel. Cost was minimized through the use of off-the-shelf components. Requirements to allow for future expansion were met by choosing equipment which adheres to established industry standards for hardware and software. Data processing capabilities include narrow band and 1/3 octave spectral analysis, compensation for microphone frequency response/directivity, and correction of acoustic data to standard day conditions. The system was used successfully in a major wind tunnel test program at NASA LeRC to acquire and analyze jet noise data in support of the High Speed Civil Transport (HSCT) program. Author

N92-24800* Eagle Engineering, Inc., Hampton, VA.

A SUMMARY OF XB-70 SONIC BOOM SIGNATURE DATA Final Report

DOMENIC J. MAGLIERI, VICTOR E. SOTHCOTT, and THOMAS N. KEEFER, JR. Apr. 1992 60 p

(Contract NAS9-17900; RTOP 537-03-21-04)

(NASA-CR-189630; NAS 1.26:189630) Avail: NTIS HC/MF A04 CSCL 20A

A compilation is provided of measured sonic boom signature data derived from 39 supersonic flights (43 passes) of the XB-70 airplane over the Mach number range of 1.11 to 2.92 and an altitude range of 30500 to 70300 ft. These tables represent a convenient hard copy version of available electronic files which include over 300 digitized sonic boom signatures with their corresponding spectra. Also included in the electronic files is information regarding ground track position, aircraft operating conditions, and surface and upper air weather observations for each of the 43 supersonic passes. In addition to the sonic boom signature data, a description is also provided of the XB-70 data base that was placed on electronic files along with a description of the method used to scan and digitize the analog/oscillograph sonic boom signature time histories. Such information is intended to enhance the value and utilization of the electronic files.

Author

N92-25368*# Douglas Aircraft Co., Inc., Long Beach, CA.
**INTERIOR NOISE PREDICTION METHODOLOGY: ATDAC
 THEORY AND VALIDATION**

GOPAL P. MATHUR and BRYCE K. GARDNER Apr. 1992
 48 p
 (Contract NAS1-18037; RTOP 535-03-11-03)
 (NASA-CR-187626; NAS 1.26:187626) Avail: NTIS HC/MF A03

The Acoustical Theory for Design of Aircraft Cabins (ATDAC) is a computer program developed to predict interior noise levels inside aircraft and to evaluate the effects of different aircraft configurations on the aircraft acoustical environment. The primary motivation for development of this program is the special interior noise problems associated with advanced turboprop (ATP) aircraft where there is a tonal, low frequency noise problem. Prediction of interior noise levels requires knowledge of the energy sources, the transmission paths, and the relationship between the energy variable and the sound pressure level. The energy sources include engine noise, both airborne and structure-borne; turbulent boundary layer noise; and interior noise sources such as air conditioner noise and auxiliary power unit noise. Since propeller and engine noise prediction programs are widely available, they are not included in ATDAC. Airborne engine noise from any prediction or measurement may be input to this program. This report describes the theory and equations implemented in the ATDAC program.

Author

N92-26130*# Wyle Labs., Inc., El Segundo, CA.
**EVALUATION OF HUMAN RESPONSE TO STRUCTURAL
 VIBRATIONS INDUCED BY SONIC BOOMS**

LOUIS C. SUTHERLAND (Sutherland, Louis C., Rancho Palos Verdes, CA) and J. CZECH May 1992 120 p Prepared for Douglas Aircraft Co., Inc., Long Beach, CA
 (Contract NAS1-19060; RTOP 537-03-21-03)
 (NASA-CR-189584; NAS 1.26:189584; WYLE-WR-91-20) Avail: NTIS HC/MF A06

The topic is addressed of building vibration response to sonic boom and the evaluation of the associated human response to this vibration. An attempt is made to reexamine some of the issues addressed previously and to offer fresh insight that may assist in reassessing the potential impact of sonic boom over populated areas. Human response to vibration is reviewed first and a new human vibration response criterion curve is developed as a function of frequency. The difference between response to steady state versus impulsive vibration is addressed and a 'vibration exposure' or 'vibration energy' descriptor is suggested as one possible way to evaluate duration effects on response to transient vibration from sonic booms. New data on the acoustic signature of rattling objects are presented along with a review of existing data on the occurrence of rattle. Structural response to sonic boom is reviewed and a new descriptor, 'Acceleration Exposure Level' is suggested which can be easily determined from the Fourier Spectrum of a sonic boom. A preliminary assessment of potential impact from sonic booms is provided in terms of human response to vibration and detection of rattle based on a synthesis of the preceding material.

Author

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SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

A92-36950
**TOTAL QUALITY TREATMENT FOR SCIENCE AND
 TECHNOLOGY**

ROBERT R. RANKINE, JR. (USAF, Systems Command, Andrews

AFB, DC) Aerospace America (ISSN 0740-722X), vol. 30, no. 5, May 1992, p. 36-40.

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A review is presented of the organizational total quality management techniques applied to the planning process for science and technology programs in the laboratories of the USAF. Specifically, this involves the creation of metrics that assess vital aspects of the programs and provide a basis for continuing improvement. Consideration is given to the management of the hundreds of improvements, involving thousands of technical details, required for the technology that goes into better airframes, engines, avionics and weapons for fighters, as well as for technologies that support other weapon systems. Attention is given to certain total quality management aspects including, the work of the technology executive officer, the advanced technology transition demonstrations, and technology area plans.

R.E.P.

A92-39244

**OPENING CLOSED SKIES - THE PROSPECTS FOR FURTHER
 LIBERALIZATION OF TRADE IN INTERNATIONAL AIR
 TRANSPORT SERVICES**

BRUCE STOCKFISH (Department of Justice, Ottawa, Canada)
 Journal of Air Law and Commerce (ISSN 0021-8642), vol. 57, no. 3, Spring 1992, p. 599-652. refs

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An examination is conducted of courses for the development of liberalized regulatory regimens concerning international air transport services. After characterizing the evolution of regulation and the experience of deregulation in both domestic and international air transport, attention is given to current obstructions to further liberalization and a range of unilateral, bilateral, and multilateral measures that may be taken to further air transport liberalization. The bulk of plausible progress is expected to be made bilaterally or in multilateral regional contexts.

O.C.

A92-39245

**SALVAGING THE WRECKAGE - MULTIDISTRICT LITIGATION
 AND AVIATION**

KYLE BRACKIN Journal of Air Law and Commerce (ISSN 0021-8642), vol. 57, no. 3, Spring 1992, p. 655-714. refs

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An examination is conducted of problems that are endemic in the mass aviation torts field, with a view to tentative solutions. Attention is given to the adaptation of multidistrict litigation in the Federal courts to cope with mass aviation accidents, exposing specific areas of conflict. Several alternatives for legislative and judicial action contain viable options for management of a growing mass tort caseload. If Congress decides not to create a Federal common law in this area, it should at least specify how Federal courts should choose the state whose law will govern the case.

O.C.

A92-39563

**AVIATION PRODUCTS LIABILITY AND NAVIGATION -
 RECENT DEVELOPMENTS AND FUTURE DIRECTIONS**

EDWIN W. GREEN and BRIAN E. CABRERA (Bronson, Bronson & McKinnon, San Francisco, CA) IN: Institute of Navigation, Annual Meeting, 47th, Williamsburg, VA, June 10-12, 1991, Proceedings. Washington, DC, Institute of Navigation, 1991, p. 301-305. refs

General principles of liability which arise concerning navigational equipment in the aviation context, as well as some of the recent case law on the subject are discussed. Examples of recent Congressional legislation aimed at improving general aviation liability laws are presented. Present and future developments in aviation navigation and the legal implications of such changes are examined.

C.A.B.

N92-25204# RAND Corp., Santa Monica, CA. National Defense Research Inst.

**WHEN SHOULD WE START HIGH-RATE PRODUCTION OF
 THE B-2? AN ANALYSIS BASED ON FLIGHT TEST RESULTS**

17 SOCIAL SCIENCES

MICHAEL D. RICH and GILES K. SMITH 26 Jul. 1991 24 p
Sponsored by Office of the Secretary of Defense
(RAND/P-7757) Avail: NTIS HC/MF A03

In 1987, the Under Secretary of Defense for Acquisition requested that RAND conduct a study of the acquisition strategy of what was then known as the Advanced Technology Bomber. Initial results gave high marks to the risk reduction measures taken in the early phases of the program. However, considerable concern about the planned pace of the flight test program was expressed. Rand was asked to continue its analysis of the program's acquisition strategy. One of the questions tackled was how to tie production commitments to progress achieved in the test program, which was one of the original recommendations made in the preliminary study. This report describes the above continuing evaluation of the B-2 bomber program acquisition strategy. H.A.

N92-25606# Committee on Commerce, Science, and Transportation (U.S. Senate).

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AUTHORIZATION ACT, 1993

ALBERT GORE, JR. Washington GPO 9 Apr. 1992 12 p
S. 2558 enacted into law by the 102d Congress, 2d Session, 9 Apr. 1992

(S-2558-IS) Avail: Document Room, Senate, Washington, DC
20510 HC free

The bill is presented which was presented to the 102nd congress to authorized appropriations to NASA for research and development, space flight, control and data communications, construction of facilities, and research and program management, and Inspector General, and for other purposes. The bill has been read twice and referred to the Committee on Commerce, Science, and Transportation. Author

physics, physical combustion chemistry, thermodynamics, construction methods and design research, process engineering, and telecommunications. Some of the topics covered include: high performance lasers for aerospace applications; laser development; combustion products of hazardous materials; solar radiation conversion to chemical energy; development of a latent heat accumulator; continuous fiber reinforced thermoplastics; ceramic fibers; an absorption heat pump; and digital radio broadcasting.

K.S.

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GENERAL

N92-25413# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).

DLR-NEWS: ANNOUNCEMENTS OF THE GERMAN RESEARCH INSTITUTE FOR AERONAUTICS AND ASTRONAUTICS [DLR-NACHRICHTEN: MITTEILUNGEN DER DEUTSCHEN FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT]

THOMAS H. WEYER, ed. and HELGA ZIMMERMANN, ed. Feb.
1991 52 p In GEORGIAN Original contains color illustrations
(ISSN-0937-0420) Avail: NTIS HC/MF A04

Various journal articles concerned with aeronautics, astronautics, and energy technology are presented. Some of the topics covered include: locating acoustic blade-vortex interaction sources; prediction of laminar-turbulent transition in laminar flow; an airworthy experimental system for modern navigation and reconnaissance methods; a planning system for the Frankfurt airport; rotors in wind tunnels; interdisciplinary research cooperation in aeronautics and astronautics; process control to set mach number ratios for jet-engine intake measurements; aerodynamic configuration verifications on spacecraft; and solar energy conversion efficiency. K.S.

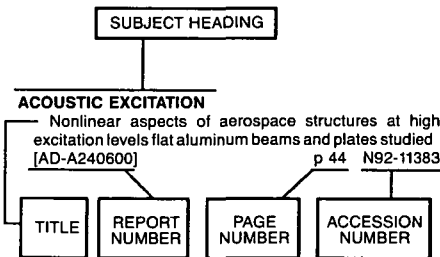
N92-26086# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).

DLR-NEWS: ANNOUNCEMENTS OF THE GERMAN RESEARCH INSTITUTE FOR AERONAUTICS AND ASTRONAUTICS [DLR-NACHRICHTEN: MITTEILUNGEN DER DEUTSCHEN FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT]

THOMAS H. WEYER, ed. and HELGA ZIMMERMANN, ed. Nov.
1991 60 p In GEORGIAN Original contains color illustrations
(ISSN-0937-0420) Avail: NTIS HC/MF A04

Various articles are presented in the areas of engineering

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of document content, a title extension is added, separated from the title by three hyphens. The accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence.

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A report on enhancements for existing and future helicopters supporting operations of the Canadian oil and gas industry [CTN-91-60126] p 636 N92-25350

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The effect of droplet sizing uncertainty on ice accretions p 679 N92-24874

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Inter-noise 90; Proceedings of the International Conference on Noise Control Engineering, Goteborg, Sweden, Aug. 13-15, 1990. Vols. 1 & 2 [ISBN 91-7848-224-0] p 693 A92-39042

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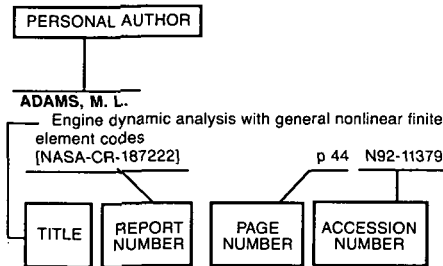
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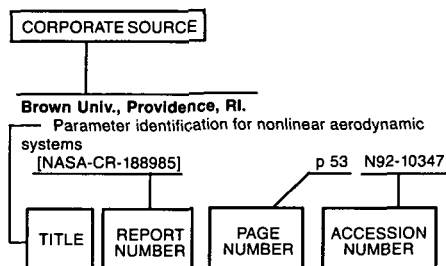
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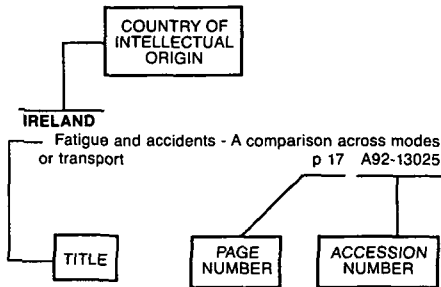
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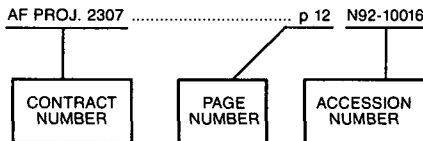
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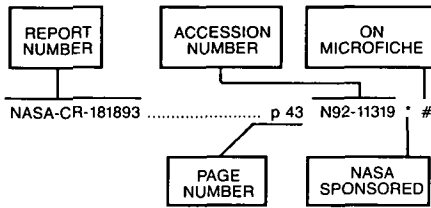
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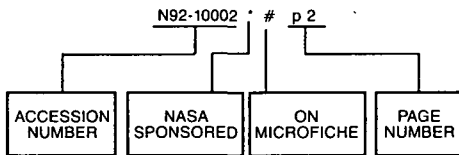
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(612) 624-5073 FAX: (612) 626-9353

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(314) 882-6733 FAX: (314) 882-8044

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UNIV. OF MONTANA
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(402) 472-2562

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NEW YORK

NEW YORK STATE LIBRARY
Documents/Gift & Exchange Section
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Cultural Education Center
Albany, NY 12230
(518) 474-5563 FAX: (518) 474-5786

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UNIV. OF NORTH CAROLINA - CHAPEL HILL
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BA/SS Dept.—Documents
Chapel Hill, NC 27599
(919) 962-1151 FAX: (919) 962-0484

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Oklahoma City, OK 73105-3298
(405) 521-2502, ext. 252, 253
FAX: (405) 525-7804

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Stillwater, OK 74078
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Millar Library
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Carolina, Thomas Cooper Library,
Columbia

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MEMPHIS STATE UNIV. LIBRARIES
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UTAH STATE UNIV.
Merrill Library & Learning Resources
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Documents Dept.
Logan, UT 84322-3000
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(804) 924-3133 FAX: (804) 924-4337

WASHINGTON

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WEST VIRGINIA UNIV. LIBRARY
Govt. Documents Section
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WISCONSIN

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In cooperation with Univ. of Wisconsin-
Madison, Memorial Library

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Documents Div.
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